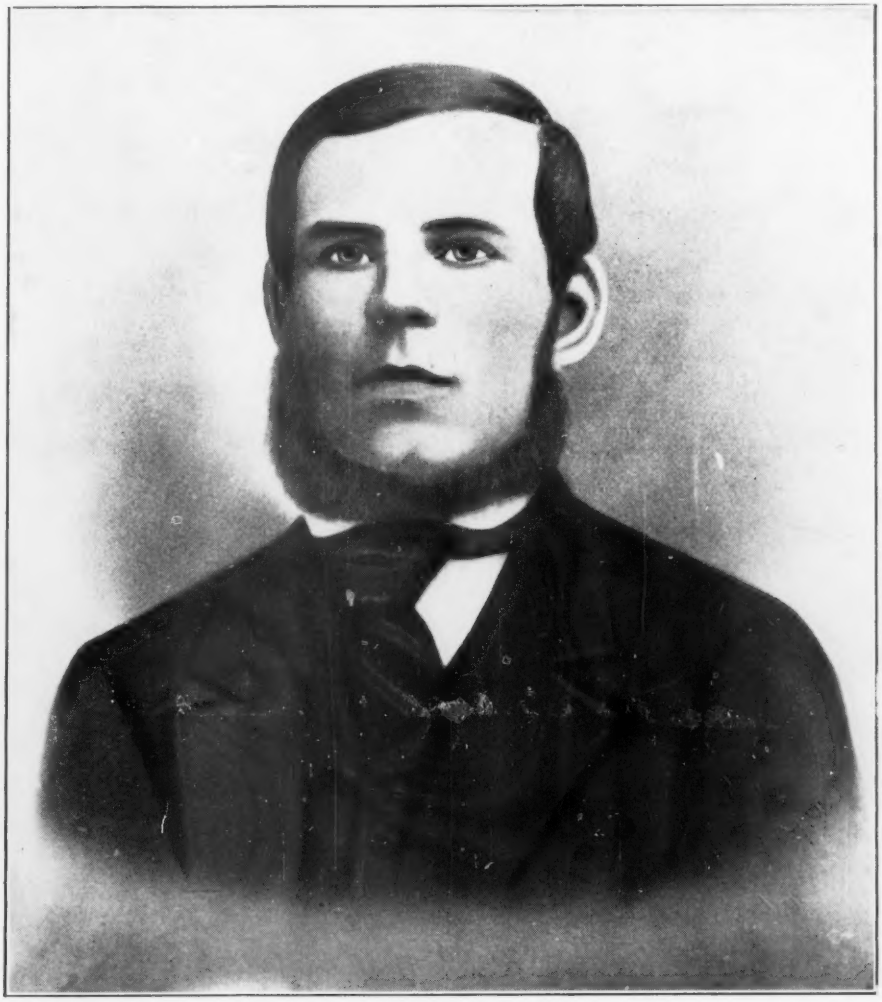
THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 17 JANUARY, 1938 Number 1



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See page 35 for story of James Tams

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Volume 17 January, 1938 Number 1

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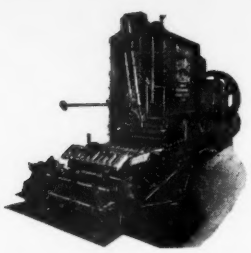

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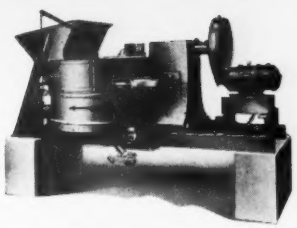

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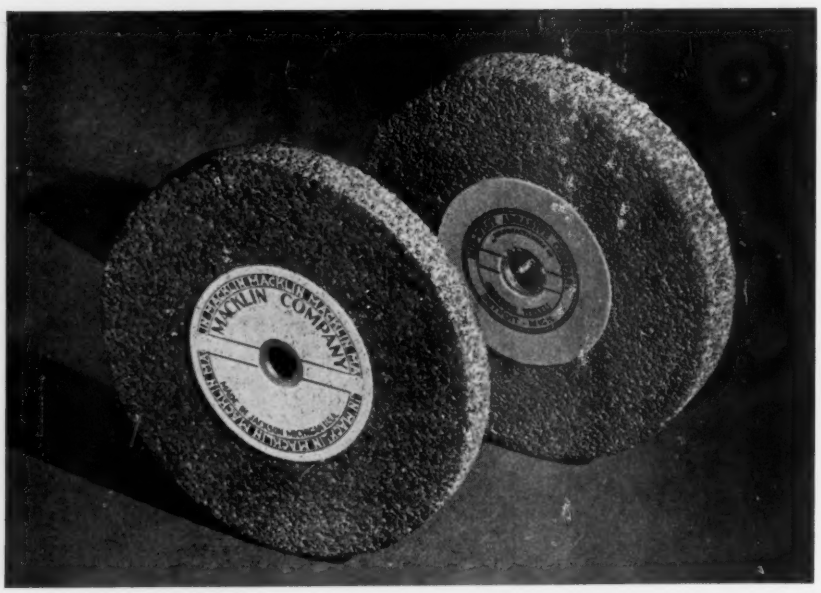

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A number are employed in the manufacture of both heavy and light refractories.

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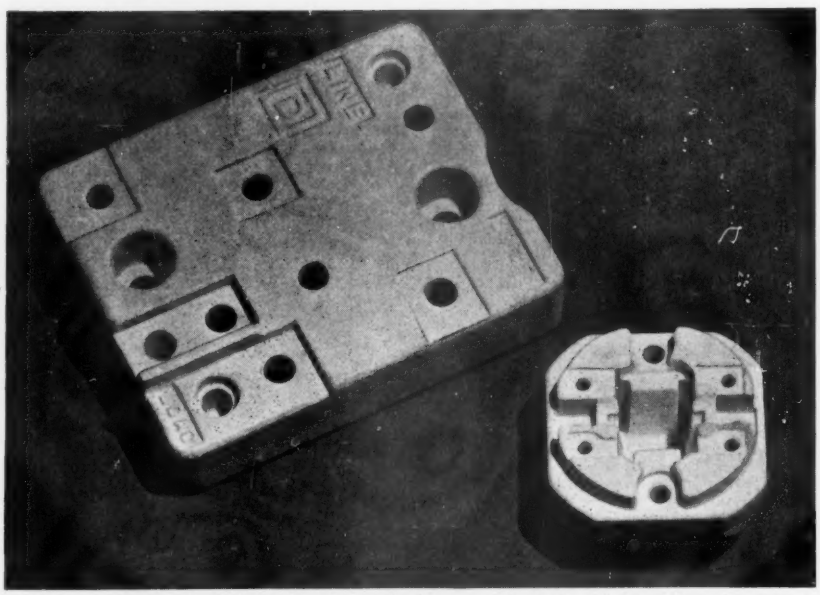

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Kentucky Clay Mining Co.
The Porcelain Enamel & Mfg. Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay Miners
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Kentucky-Tennessee Clay Co
Paper Makers Importing Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Potters)
Denver Fire Clay Co.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc
Kentucky Clay Mining Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
Sant, Richard C.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Process Equipment)
Lancaster Iron Works, Inc.

Clay (Sagger)
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Paper Makers Importing Co.
Pittsburgh Plate Glass Co.
Potters Supply Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Wad)
Kentucky Clay Mining Co.
Potters Supply Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Clay (Wall Tile)
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Kentucky Clay Mining Co.
Paper Makers Importing Co.
Sant, Richard C.
Spinks Clay Co., H. C.
United Clay Mines Corp.

Cleaners
The Porcelain Enamel and Mfg. Co.

Cleaners, Chemical
Harshaw Chemical Co.

Clocks (Gauge Board)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Harshaw Chemical Co.
The Porcelain Enamel and Mfg. Co
The Vitro Mfg. Co.

Cobalt Sulphate
Harshaw Chemical Co.

Colors
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Harshaw Chemical Co.
Pittsburgh Plate Glass Co.
The Porcelain Enamel and Mfg. Co
The Vitro Mfg. Co.

Cones
The Edward Orton, Jr., Ceramic Foundation

Conveying Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Copper Oxide
Harshaw Chemical Co.

Corhart
Corhart Refractories Co.

Cornwall Stone (Imported)
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co. Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Crucibles (Filter, Melting, Ignition)
Carborundum Co.
Denver Fire Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Potters Supply Co.

Crushers (Clay)
Lancaster Iron Works, Inc.

Cryolite (see Kryolith)
Ceramic Color & Chemical Mfg. Co
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Crystolon (Refractory Products)
Norton Co.

Cullet, Washing Plants, Incinerators, Crushers
Frazier-Simplex, Inc.

Decorating Supplies
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Harshaw Chemical Co.
Pittsburgh Plate Glass Co.
The Vitro Mfg. Co.

Disintegrators
Lancaster Iron Works, Inc.

Dryer (Pipe Rack)
Lancaster Iron Works, Inc.

Drying Machinery
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
Corhart Refractories Co.

Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Norton Co. (*Alundum*)
Pittsburgh Plate Glass Co.

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
The Hommel Co., O., Inc.

Exhaust Systems
The DeVilbiss Co.

Feldspar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co
Sant, Richard C.
The Vitro Mfg. Co.

Fire Brick
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Spinks Clay Co., H. C.

Flint
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
Harshaw Chemical Co.

French Flint
Consolidated Feldspar Corp.
Paper Makers Importing Co.

Frit
Allied Engineering Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Frosting Mixtures
Harshaw Chemical Co.

Fuel Oil Systems and Control, Stokers
Bethlehem Steel Co.
Frazier-Simplex, Inc.

Furnaces
Allied Engineering Co.
Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.

Glass Bending Ovens, Glass Decorating Machines
Frazier-Simplex, Inc.

Glass Equipment
Hartford-Empire Co.
Lancaster Iron Works, Inc.

Glass Melting Pots (Open and Covered)
Pittsburgh Plate Glass Co.

Glass Melting Tanks and Furnaces
Frazier-Simplex, Inc.
Pittsburgh Plate Glass Co.

Glass Thickness Gauge
Bausch & Lomb Optical Co.

Glaze and Body Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Glazes and Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Glaze Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Goggles
Cover, H. S.
Willson Products, Inc.

Gold
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc. R. H. & Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Dept

Gold Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Co.
Granulators
Lancaster Iron Works, Inc.
Grinding Wheels
Carborundum Co. (*Carborundum and Aloxite*)
Chicago Vitreous Enamel Product Co.
Norton Co. (*Alundum-Crystolon*)
Hearths
Carborundum Co. (*Carbofrax* heat treating)
Corhart Refractories Co.
Electro Refractories & Alloys Corp.
Norton Co. (*Crystolon*)
Hearths (Fused Al_2O_3, SiC)
Electro Refractories & Alloys Corp.
Hearths (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Norton Co.
Hose (Air and Fluid)
The DeVilbiss Co.
Hydrofluoric Acid
Harshaw Chemical Co.
Iron Chromite
Harshaw Chemical Co.
Iron (Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.
Iron Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.
Kaolin
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Edgar Brothers Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
Sant, Richard C.
United Clay Mines Corp.
The Vitro Mfg. Co.
Kellog AA Refractories
Electro Refractories & Alloys Corp.
Kilns, China (Decorating)
Allied Engineering Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Kiln Furniture (Silicon Carbide, Semi-Silicon Carbide)
Electro Refractories & Alloys Corp.
Kyanite
Celo Mines, Inc.
Kryolith (See Cryolite)
Pennsylvania Salt Mfg. Co.
Laboratory Ware
Norton Co.
Lehr Tile (High Aluminous Clay, Electrically Sintered Aluminum Oxide, Silicon Carbide)
Carborundum Co.
Electro Refractories & Alloys Corp.
Lehrs
Frazier-Simplex Inc.
Lehrs (Electric or Fuel Heated)
Frazier-Simplex, Inc.
Lehr Loaders
Frazier-Simplex, Inc.
Linings (Furnace Refractory, Block Refractory Plate, Brick and Tile)
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.
The Vitro Mfg. Co.
Lithium Carbonate
Foote Mineral Co.
Lithium Minerals
Foote Mineral Co.
Magnesia (Fused)
Electro Refractories & Alloys Corp.
Norton Co.
Magnesia (Sintered, Calcined)
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Porcelain Enamel and Mfg. Co.
Magnesite
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.
Magnesite-Calcined
Foote Mineral Co.
Magnesium Carbonate
Harshaw Chemical Co.
Manganese
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc. R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.
Manganese Dioxide
Foote Mineral Co.
Manganese (Oxide)
Ceramic Color & Chemical Mfg. Co.
Corhart Refractories Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
Masks (Breathing)
The DeVilbiss Co.
Willson Products, Inc.
Metals (Porcelain Enameling)
American Rolling Mill Co.
Bethlehem Steel Co.
Microscopes (Polarizing)
Bausch & Lomb Optical Co.
Minerals
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.
Mixers (Batch)
Lancaster Iron Works, Inc.
Mold Sanders
Lancaster Iron Works, Inc.
Muffles (Furnace)
Allied Engineering Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Frazier-Simplex, Inc.
Norton Co.
Pittsburgh Plate Glass Co.
Muffles (Laboratory)
Electro Refractories & Alloys Corp.
Mullite (Refractories)
Electro Refractories & Alloys Corp.
Muriatic Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Needle Antimony
Harshaw Chemical Co.
Nickel Salts
Harshaw Chemical Co.
Nitrates (Cobalt, Sodium)
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.
Nitre
Harshaw Chemical Co.
Non-Gro Refractories
Electro Refractories & Alloys Corp.
Norbide (Norton Boron Carbide)
Norton Co.
Olivine
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Opacifiers
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I. & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Overglaze Colors
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Oxides
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
Metal & Thermit Corp.
Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Palladium Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Pins
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Potters Supply Co.
Platinum Decorations
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.
Porcelain Enameling Service (Practical)
American Rolling Mill Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Porcelain Enamel & Mfg. Co.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.
Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.
Producer Glass Plants
Frazier-Simplex, Inc.
Pug Mills
Lancaster Iron Works, Inc.
Pyrites (Natural Iron Sulphide)
Foote Mineral Co.
Pyrometer Tubes
Carborundum Co.
Electro Refractories & Alloys Corp.
Montgomery Porcelain Products Co.
Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.
Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.
Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation
Raw Material Handling Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
Refractometers
Bausch & Lomb Optical Co.
Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Kentucky-Tennessee Clay Co.
Norton Co.
Pittsburgh Plate Glass Co.
Sant, Richard C.
Titanium Alloy Mfg. Co.
Represses (Automatic)
Lancaster Iron Works, Inc.

Respirators
Chicago Vitreous Enamel Product Co.
Cover, H. S.
The DeVilbiss Co.
The Hommel Co., O., Inc.
Willson Products, Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sandblast Helmets
Willson Products, Inc.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Selenite of Sodium
Drakenfeld & Co., B. F.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
Electro Refractories & Alloys Corp.
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
The Hommel Co., O., Inc.
Harshaw Chemical Co.

Silicon Carbide
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Electro Refractories & Alloys Corp.

Sillimanite (Synthetic)
Pittsburgh Plate Glass Co.

Slabs (Furnace)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pittsburgh Plate Glass Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sodium Metasilicate
Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Uranate
Harshaw Chemical Co.

Soot Blowers
Frazier-Simplex, Inc.

Special Machines
Frazier-Simplex, Inc.

Spar
Ceramic Color & Chemical Mfg. Co.
Consolidated Feldspar Corp.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Spray Booths
The DeVilbiss Co.

Spraying Equipment
The DeVilbiss Co.

Spurs
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Stilts
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Tanks
Frazier-Simplex, Inc.

Tank Blocks
Corhart Refractories Co.
Pittsburgh Plate Glass Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Tanks for Raw Material Steel or Concrete
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Electro Refractories & Alloys Corp.
Norton Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
Norton Co.
Pittsburgh Plate Glass Co.

Tile (Wall)
Denver Fire Clay Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld & Co., B. F.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy Mfg. Co.
The Vitro Mfg. Co.

Tri Sodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
Electro Refractories & Alloys Corp.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.
Pittsburgh Plate Glass Co.

Uranium Oxide
Harshaw Chemical Co.

Uronium Oxide (Yellow-Orange-Black)
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Vitro Mfg. Co.

Water Softening Plants
Frazier-Simplex, Inc.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
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FIRST RUN	577	447	46,326	417,978	138,978	279,000	484	62,920	355,058	7,664
SECOND RUN	708	637	76,446	562,400	229,338	333,062	470.4	33,398	529,002	6,920

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PAPERS

FACTORS INFLUENCING PARTICLE SIZE AND SHAPE IN GRINDING*

By Lincoln T. Work

Abstract

The unit operation most commonly used to change particle size and shape is grinding, and classification is an adjunct to it. The cost of grinding depends upon the nature of the raw materials to be ground, the choice of milling equipment and processing procedure, and whether or not classification is used. This paper presents a review of the several factors influencing the preparation of refractory aggregates.

I. Particle Size and Shape

In the process of crushing, particles of many sizes and shapes are produced. The problem of measurement is therefore essentially a statistical problem, the solution of which includes the study of (1) the size of the individual particle, (2) the distribution of particle size, and (3) the shape of the particles.

Inasmuch as most of the materials whose particle size is to be measured are irregular in form, so that one dimension of the particle bears no fixed relation to another, it is necessary to accept some dimensional characteristic as the criterion of size. The three dimensions may be designated in decreasing order of size as *a*, length; *b*, breadth; and *c*, thickness. The several methods of test measure these differently.

(1) Sieve Measurement

For example, in sieving, the smallest cross-section (a composite of the *b* and *c*) controls. Flat particles, however, pass a sieve with the *b* dimension approximating the diagonal of the aperture. Under ordinary conditions for sieve agitation, the *a* dimension plays no important part. It may, however, become significant if it is several times that of the *b* value or if agitation is poor.

(2) Microscopic Measurement

With the use of the microscope, there is more freedom in the choice of dimensions. Two of them, *a* and *b*, are normally visible in dry mounts. For ground products, the *b* dimension represents approximately a mean of the three dimensions. It usually falls about midway between sieve aperture and diagonal, and it is commonly used as a good criterion of size. In mounted media, it is not uncommon to use an estimated average of the two visible dimensions. Owing to the fact that orientation is not so pronounced in a gum mount, this estimated average approximates a mean diameter. A special diameter known as the statistical mean has been proposed. Using a scale set in one direction of the microscope field, the distance from edge to edge of the particle may be measured when the scale divides it into equal areas above and below the line. It must be noted that in this method the orientation

* Presented at the Thirty-Eighth Annual Meeting, American Ceramic Society, Columbus, Ohio, April 1, 1936 (Refractories Division). This is the final paper included in the Symposium on "Production of Dense Aggregates"; for these papers, see *Bull. Amer. Ceram. Soc.*, **16** [1] 7–13 (1937); *Jour. Amer. Ceram. Soc.*, **20** [5] 155–66 (1937).

of the particle affects the measurement of size; that is, the same particle measured at different angles would be assigned a different diameter at each position of measurement. This statistical mean does not appear to have fundamental significance, and convenience combined with a reasonable judgment should be the basis in selecting the particle dimension to be used.

(3) Sedimentation Measurement

Settling methods measure a diameter, often called a Stoke's law diameter, which is a hypothetical diameter equal to that of a sphere which would settle at the same rate. The special value of the use of such a diameter in settling tests lies in the fact that it is the criterion of separation and needs no further correlation with the test.

Until methods for defining the size of an individual particle are standardized, it is necessary to know the diametral criterion. Curves of distribution for any of these methods of measurement are usually similar, but the actual values of diameter differ with the criteria.

(4) Distribution of Particle Size

The distribution of particle size is the composite of measurements or separation tests to which statistically large groups have been subjected. This may be measured by any of the several methods or combinations of them, providing diameters are properly correlated. In the coarser ranges, *i.e.*, above 50 microns, sieves may be used. If the distribution of material below the No. 325 sieve is desired, separation by elutriation in air or in liquid may be effective. The diametral criteria are different, and it is therefore necessary to create an artificial scale either for the sieve or the settling velocity by experimental measurement at the point where these methods overlap. This may be done by microscopic measurement. Other methods for measuring the distribution in fine sizes include microscopic measurement and counting, sedimentation with periodic weighing or with measurement of density, and turbidimeter measurement during sedimentation.

Distribution curves are commonly represented in one of two ways. (1) The cumulative percentage on sieves, or in general cumulative percentage, is plotted against diameter, giving a curve which is roughly S-shaped and which is independent of the diameters at which readings are taken. Because the curve must register the entire percentage, it is not sensitive over any small interval. (2) In the finer sizes, it is customary to plot per cent per micron, weight, or frequency, against diameter, which usually results in a skewed probability curve (Fig. 1), or occasionally one with two modes. This type is more sensitive than the cumulative percentage because it may be fitted to a scale limited only by the height of the mode.

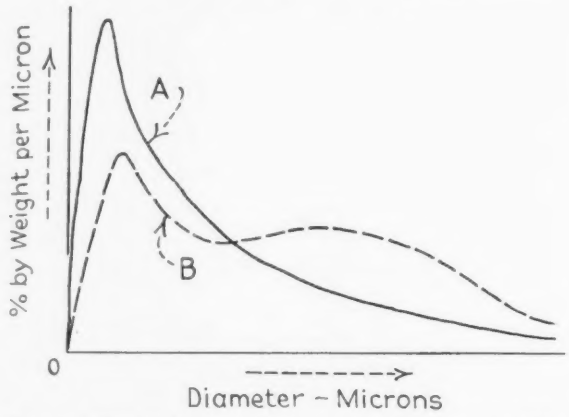

FIG. 1.—Size-distribution curves; *A*, usual curve with one apparent mode; *B*, bimodal curve.

The evaluation of shape is still very indefinite, but qualitative observation under the microscope reveals a great deal of information. A more quantitative estimation may be made by fitting particles to certain forms as circles, rectangles, or triangles, and by noting the percentage of each form in each size range. Where the material may be separated, comparison of two dimensions will yield an arbitrary shape factor. For example, distribution curves in *a* and *b* dimensions in sieve cuts may be used.

A number of efforts have been made to develop statistical relations for the distribution curves of ground products. Gaudin[1] has plotted the results of sieve tests on ground homogeneous material. Using a nest of sieves with apertures increasing by the square root of two, he has found that a straight line results over the range of fine sizes, if the logarithm of percentage on sieve is plotted against diameter. Martin[2] studied the fineness of silica ground in a ball mill and showed

[1] A. M. Gaudin, "An Investigation of Crushing Phenomena," *Mining Met. Soc. Amer. Bull.*, No. 1665B (Feb., 1926).

[2] G. Martin, *et al.*, "Researches on the Theory of Fine Grinding," *Trans. Ceram. Soc.* [Eng.], **23**, 61 (1923–24); *Ceram. Abs.*, **3** [11] 330 (1924).

that the logarithm of particle frequency in a unit interval of diameter plotted against the diameter yielded a straight line, but he did not carry his size measurements to the smallest sizes of the product. Gaudin's relation showed that for the finer particle sizes the percentage on sieve could be expressed in terms of the diameter to a fixed exponent, whereas Martin, dealing with the coarser sizes, found an exponential relation in which the diameter was the exponent. Rosin and Rammler[3] have endeavored to cover the entire region on a cumulative curve showing an exponential relation in which a ratio of diameters becomes the exponent. Work[4] has shown that no single function completely expresses fineness distribution of ground materials, and he has developed a combination of the functions of Gaudin and Martin. Particle fracture appears to follow the exponential of Martin, while an incidental secondary breakage, possibly due to attrition, follows a combination of the Martin and Gaudin relations. Roller[5] has recently contributed a single relation in which elements somewhat similar to the Work secondary relation appear.

Studies along this line have been limited by the incompleteness of most of the measurements of particle size made on ground products. The scope of application of the relations is further limited for coarse grains by the sizing action of certain grinding devices, and it may be limited in the finer sizes by the application of classifying action to the grinding device.

II. The Raw Material

The nature of the raw material plays an important part in the grinding operation, and it is generally beyond the control of the mill operator. Some materials are soft and readily broken, others are hard, and still others may possess a degree of elasticity as differentiated from brittleness. Under the initial lead of Hardgrove,[6] grindability measurements have been made on a large number of materials. The test is essentially one of crushing a sized feed for a fixed period of time in a standardized mill and calculating the new surface produced from the sieve analysis of the product. There are some indications in the literature that free grinding, *i.e.*, grinding unimpeded by fines, may be accomplished with an overall-power consumption proportionate to the new surface developed. The grindability test aims to prevent impedance from fines, but it is subject to error because it takes a sized fraction as representative of the entire sample when the material is in fact nonuniform. The measurement of a new surface, moreover, is determined by sieving and does not take cognizance of subsieve distribution. It is, however, well standardized and is a practical basis for estimation of mill capacity.

In many cases there are possibilities of altering the grindability of raw materials. Minerals may be pre-processed by the action of heat to cause stresses within the mass and to render them susceptible to easy mechanical disintegration. The composition and heat treatment of certain refractories made industrially may be modified in such a way as to produce the desired grinding characteristics. As an adjunct to the method of grinding, these raw materials may be processed in such a way as to produce fewer fine particles and a greater number of particles of useful sizes. Some control of the shape of the particle may be exercised through the processing of the material. Wherever this is possible, it should be studied as a factor in the character of the final product and the cost of producing it.

III. Method of Milling

Milling devices vary both in structural features and in the principle on which they operate. Work[7] has previously classified them into five types to which must be added a sixth, which has become of considerable importance in recent years.

These mills* include the following types: (1) direct-pressure mills, such as jaw and gyratory crushers, stamp mills, and the Symons cone crushers; (2) roller mills, such as single- or double-roll crushers, differential rolls, Chilean mill, centrifugal roll mills, and ball-plate or roller-plate

[3] P. Rosin and R. Rammler, "Laws Governing the Fineness of Powdered Coal," *Jour. Inst. Fuel*, **7**, 29 (1933).

[4] L. T. Work, "Analysis of Crushing and Pulverizing Processes," *Trans. Amer. Soc. Mech. Eng.* [Research Paper], Nos. 55–56 (1932).

[5] P. S. Roller, "Law of Size Distribution and Statistical Description of Particulate Materials," *Jour. Franklin Inst.*, **223**, 609–33 (1937).

[6] R. M. Hardgrove, "Grindability of Coal," *Trans. Amer. Soc. Mech. Engrs.*, **54** [F.S.P.–54–55] p. 37 (1932). *Ceram. Abs.*, **11** [6] 383 (1932).

[7] L. T. Work, "Crushing and Pulverization," *Ind. Eng. Chem.*, **21**, 498 (May, 1929); *Ceram. Abs.*, **9** [3] 213 (1930).

* For a description of many of these mills, see G. F. Metz, "Grinding Ceramic Materials in Ball, Pebble, Rod, and Tube Mills," *Bull. Amer. Ceram. Soc.*, **16** [12] 461–67 (1937).

mills; (3) tube mills, such as the ball or pebble mill and the rod mill; (4) beater mills, such as the impact or hammer type, and cage mills; (5) revolving plate mills, such as disk mills, buhr stones, and certain colloid mills; and (6) jet mills.

In addition to these devices, which are well known, some special mills of considerable interest have recently been developed. The gyratory mill has been modified so that the gyrating spindle operates in sections, thus producing a more uniform load on the shaft. The complexity of this device necessitates the use of liquid both to lubricate and to prevent dust from reaching the moving parts of the mill. The net result of these changes has been to make this crusher available for finer sizes than are ordinarily to be had with the gyratory mill. The Hadsell mill for ore reduction consists of a cylinder with lifting shelves on its interior. These shelves discharge material near the top of the circular path permitting it to drop on the breaker plates. There is also the jet mill, where streams of particles are given a high velocity by a pressure jet and are compelled to impact against each other or against a breaker plate.

A number of modifications within the well-known classes of mills has been made, especially with respect to the more general use of air-sweeping methods and of warm air to dry the feed. The continuing efforts to use mills for finer and finer grinding have resulted in modifications of mill speed with the impact type and the nature of the ball loading with the ball mill. Apart from grinding devices, disintegration has been accomplished by the quenching of heated materials so rapidly as to produce internal stress and consequent rupture.

Although the actual energy required for crushing and pulverization may depend upon grindability of the material, the effectiveness of mills in converting energy into grinding effort differs materially. Many terms have been used to define the action of mills in the reduction of material; in fact, there are those who have contended that a given mill is an attrition mill, where others have insisted that the same mill is an impact grinder. Considerable study will be necessary, therefore, before the actual nature of any mill action is fully defined. It will be well, perhaps, to simplify the number of terms from the dozen or more commonly used to two or three, such as impact, direct-compression, and attrition. The character of the finished product may be materially affected by the extent to which each of these factors acts upon it. Impact will tend to produce less impalpable powder, while attrition will tend to produce the greatest amount.

Aside from this question of principles, there is the question of the operating variables and maintenance characteristics of each of the mills available within the several types. To discuss this in detail is beyond the scope of this paper.

IV. Classification

Classification is frequently associated with milling. By means of it, material is removed from the mill after a preliminary crushing, the desired sizes of particles are removed, and the oversize is returned to the mill for further crushing. This selection may be done by means of sieves or, depending upon the grinding medium, by air or liquid classifying devices. Such a procedure alters the fineness distribution of a product, producing, in general, less of exceedingly fine sizes and a more uniform distribution over the entire range of size (Fig. 2). The net result is the production of less surface. The product, however, may be entirely suitable in that it has no objectionable oversize.

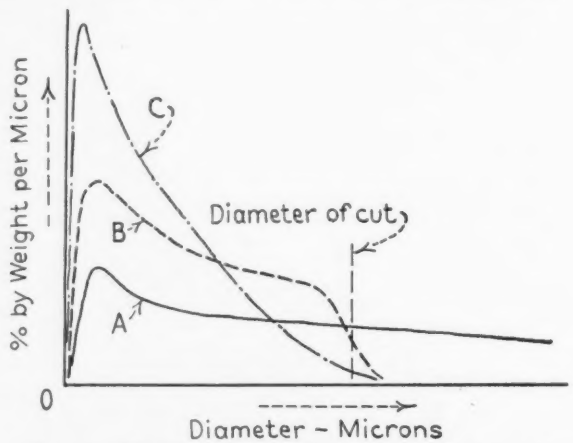

FIG. 2.—Classification *vs.* direct grinding: *A*, rough grind for classification; *B*, classified product; *C*, ground product of same maximum size as classified product.

The practical limit of size cuts with sieves may be considered to be about 100 or 200 microns. Finer sieves and bolting cloth have been used, but the cost of operation becomes increasingly greater with these finer separating devices. Fluid separating devices, particularly those using water, may operate to much smaller sizes, but with most of these the cost of operation becomes very high when they operate below 15 or 20 microns. Because of the greater settling velocities possible in

air, such methods should be effective to very fine sizes, but the mobility of the medium presents serious problems of re-circulation, and the size overlap with air separators is generally large.

In this survey, an effort has been made to show the principles which control the disintegration of ceramic materials. There are many opportunities for improvement along the suggestions outlined.

HAVEMEYER HALL
COLUMBIA UNIVERSITY
NEW YORK, N. Y.

THE ABILITY OF SOME UNDERSLIPS AND GLAZES TO COVER SURFACE IMPERFECTIONS*

BY J. F. MCMAHON

ABSTRACT

A test was developed for measuring the ability of underslips and glazes to cover surface imperfections, such as drying cracks, cavities caused by particles of coal, and firing cracks. This is important in the production of glazed heavy clay products which must frequently be made of coarsely ground impure clays. It was found that the ability of underslips to cover such surface blemishes varies widely, owing to the types and amounts of plastic clay used. Cracks over coal particles usually originate in drying and open up upon firing. The ability of glazes to cover surface imperfections depends chiefly upon the plastic clay content and upon the amounts and types of frits employed. Extremely fluid glazes fill and cover blemishes better than glazes of medium fluidity at furnace temperatures, although extremely viscous glazes cover but do not fill them. Lead-fritted glazes, in addition to their nonpoisonous properties, proved better than a raw lead glaze of the same composition. Clays containing particles of coal or other combustible matter should be screened through at least a 16- or 20-mesh sieve to reduce the harmful effects of this material.

I. Introduction

In the production of glazed heavy clay products, such as brick, terra cotta, and fireclay sanitary ware, the manufacturer frequently uses coarsely ground, impure clays which often develop surface drying and firing cracks and cavities, and they may also contain particles of coal and other impurities near the surface of the ware. These surface blemishes present glazing problems not encountered in the finer ceramic industries. Inability of glazes or underslips to cover these surface defects may cause heavy losses owing to the high percentage of second or scrap ware.

It was the purpose of this work to study factors controlling the ability of glazes and underslips to cover these surface imperfections and to develop special glazes and underslips for this type of work. The most feasible screening sizes for such bodies were also determined. Open cavities as well as those which develop from the burning of particles of combustible matter were investigated.

II. Material and Methods

Perforated specimens (Fig. 1) were molded from Monmouth (Illinois) clay. The perforations varied in diameters from 0.03 to 0.135 inch

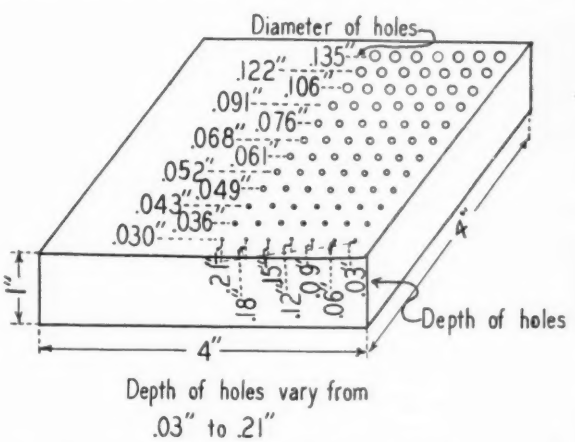

FIG. 1.—Perforated tile used to study the covering behavior of underslips and glazes.

and the depths from 0.03 to 0.21 inch. A plunger to make these perforations was constructed by cutting the heads from nails of varying diameters. These were driven into a 4- by 4-inch wooden

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* Presented at the Thirty-Ninth Annual Meeting, American Ceramic Society, New York, N. Y., March 23, 1937 (Structural Clay Products and Terra Cotta Divisions). Received July 16, 1937.

board. They were allowed to project from the surface in heights equal to the depths of the perforations. These wire projections were pressed into the plastic clay tile during molding. It was found advisable to dust the surface of the tile with dry clay before pressing the perforations to prevent sticking.

In one series of tests, these holes were left unfilled, thus simulating open cavities or cracks on dried ware. In another series, the holes were filled with powdered bituminous coal bonded with 5% clay, simulating particles of combustible matter of varying sizes near the surface to be glazed. The burning of coal underneath the glaze produced an effect similar to the development of cracks during firing. Because the holes 0.030 inch in diameter were difficult to fill with powdered coal, they were omitted from these tests.

Fifteen commercial underslips whose compositions are given in Table I were used. Underslips 1A, 1C, 1E, 1F, and 1G were the same except for different types of ball clays. They were ground in a ball mill for one hour, screened through a 60-mesh sieve, and sprayed at 44° to 47° Baumé.

Fourteen low-fire and five cone 6 glazes, representative of different types, were studied (Tables II and III).

The low-fire glazes may be divided into five classes as follows: (1) glazes containing 83.0 to 88.0% frit, 5 to 9% Ga. kaolin, and 4.0 to 9.0% tin oxide or Opax, which include glazes 2B, 2C, 2F, 2G, 2K, 2L, 2N, and 2O; (2) those containing 91.4 to 94.0% frit and 6 to 8% Ga. kaolin (glazes 2E and 2M); (3) glazes containing 37 to 55% frit (glazes 2J and 2SA); (4) raw lead glaze 2H; and (5) raw colemanite borax glaze 2Q.

Glaze 2SA has approximately the same composition as 2H, except that in 2SA the lead and silica are added as a lead bisilicate frit, whereas in 2H they are introduced as raw white lead and potters' flint.

The underslips were sprayed to a dry thickness of about 0.008 inch, while the glazes were sprayed to an average thickness of 0.014 to 0.018 inch.

III. Discussion of Results

(1) Underslips on Open Cavities

The results of tests of the ability of underslips to cover open cavities during and after drying are given in Table IV. It is evident that some underslips have decidedly better covering ability than others. Underslip 1Q, which has very low shrinkage, judging from the low plastic clay content, has only 64% of the covering power of underslip 1I of comparatively high shrinkage. It is evident, therefore, that any theory to explain the covering characteristics of underslips would have to take into account other factors than shrinkage. Their water retentivity and resistance to cracking during drying are probably important.

The influence of different ball clays in an underslip is given in Table V. Underslip 1E has almost twice the covering power of 1A, and this difference must be ascribed wholly to differences in

TABLE I

COMPOSITIONS OF UNDERSLIPS

Underslips	1A	1B	1C	1E	1F	1G	1H	1I	1J	1K	1L	1M	1N	1O	1Q
English china clay	32.5	22.5	32.5	32.5	32.5	32.5		40.0	33.2	25.0		20.0	19.0	15.0	
Ball clay No. 1	20.9	20.9							8.9	20.0	25.0		19.0		15.3
Ball clay No. 2			20.9									20.0		15.0	
Ball clay No. 4				20.9											
Ball clay No. 5					20.9										
Ball clay No. 7						20.9									
Monmouth clay							100.0	40.0	22.1		30.0				
Calcined kaolin															19.1
Cornwall stone	41.0	41.0	41.0	41.0	41.0	41.0			19.9	45.0	45.0	30.0		35.0	34.3
Feldspar								20.0	11.0				35.7		
Whiting		10.0											7.0		
Flint	5.0	5.0	5.0	5.0	5.0	5.0			4.4	10.0		30.0	19.0	35.0	7.6
Zircopax															22.9
Soda ash	0.6	0.6	0.6	0.6	0.6	0.6			0.5				0.3		0.8
Plastic material (%)	53.4	43.4	53.4	53.4	53.4	53.4	50.0	60.0	53.1	45.0	40.0	40.0	38.0	30.0	15.3
Nonplastic material (%)	46.6	56.6	46.6	46.6	46.6	46.6	50.0	40.0	46.9	55.0	60.0	60.0	62.0	70.0	84.7
Ratio plastic to nonplastic	1.14	0.77	1.14	1.14	1.14	1.14	1.0	1.5	1.13	0.82	0.67	0.67	0.61	0.43	0.18

TABLE II

COMPOSITIONS OF GLAZES

	Cone 06 to 03 glazes													Cone 6 glazes				
	2B	2C	2E	2F	2G	2H	2J	2K	2L	2M	2N	2O	2Q	2SA	2T	2V	2X	2Y	2Z
Buckingham feldspar						34.73	27.3						32.3	31.3			40.50	37.60	51.50
Mimpro feldspar															40.50	51.50			
White lead						39.40													
Whiting						3.05	6.1							2.76	9.69	6.25	9.69	5.75	6.25
Raw zinc oxide						2.44								2.20	6.88	6.00	6.88	4.40	6.00
Calcined zinc oxide													6.1						
Magnesium carbonate						2.59								2.34					
Barium carbonate													16.0		4.94	15.50	4.94	11.90	15.50
Steatite															1.69	6.11	1.69	1.95	6.11
Colemanite													11.1						
Ga. kaolin	7.2	6.6	8.4	5.0	7.3	2.44	6.3	5.9	8.3	6.0	8.3	8.3		2.20	7.5	6.25	7.5	4.70	6.25
Flint						10.80	14.1						27.7		24.0	2.49	24.0	26.8	2.49
Tin oxide	6.3	5.9		4.3	7.7	4.55	9.2						6.2	4.12					
Opax								8.6	8.3		8.3	8.3			5.0	5.90	5.00	4.25	5.90
Frit B	86.5																		
" C		87.5																	
" E			91.6																
" F				90.7															
" G					85.0														
" G7							37.0												
" K								85.5											
" L									83.4										
" M										94.0									
" N											83.4								
" O												83.4							
Lead bisilicate														55.08					

TABLE III

CHEMICAL COMPOSITIONS OF FRITS

Frit	NaKO	CaO	BaO	SrO	ZnO	PbO	CaF_2	B_2O_3	Al_2O_3	SiO_2	ZrO_2
3	4.78	5.60				27.3		10.72	3.12	42.28	
C	7.61	6.20				18.23		15.48	4.29	36.35	
E	13.45			24.3				12.45	3.57	46.20	
F	14.80							15.67	8.58	30.40	
G	24.96	4.90						10.99	11.30	45.20	
G7	10.00		20.00		20.00			20.00		30.00	
K	5.21	6.00	8.00		16.00		4.00	10.00	1.00	39.79	10.00
L	4.32	4.98	6.64		13.28	17.01	3.32	8.30	0.83	33.02	8.30
M	3.68	4.41				30.46		12.60	3.41	42.82	2.30
N	6.46					59.17		14.53		19.84	
O	10.00		20.00		20.00			20.00		30.00	

TABLE IV

PROPERTIES OF UNDERSLIPS WHEN SPRAYED ON PERFORATED TILE

Underslips	Tendency to cover holes during spraying	Percentage of holes remaining covered after drying (diameter of holes in inches)					Dry thickness of underslip (in.)	
		0.030	0.036	0.043	0.049	Av.	Smooth area	Near holes
1I	Strong	100.0	66.0	49.9	50.5	66.6	0.008	0.009
1E	Strong	69.6	78.2	57.1	53.6	64.6	0.007	0.007
1N	Strong*	52.1	59.1	62.5	71.8	61.4	0.011	0.011
1O	Moderate	78.5	54.7	40.3	41.5	53.7	0.009	0.008
1B	Slight*	78.4	52.6	44.3	31.6	51.7	0.007	0.011
1C	Slight	53.2	52.1	52.1	45.1	50.6	0.008	0.011
1M	Moderate	55.2	37.7	38.0	43.2	43.5	0.011	0.009
1Q	Poor	44.4	47.4	39.6	39.3	42.7	0.009	0.009
1F	Poor	43.7	35.6	41.4	49.0	42.4	0.009	0.013
1K	Slight	32.7	48.0	44.5	37.3	40.6	0.008	0.008
1G	Poor	54.7	30.5	40.9	34.6	40.2	0.007	0.012
1L	Moderate*	72.5	50.0	29.9	7.6	39.9	0.007	0.009
1J	Poor	31.7	38.6	35.2	41.4	36.7	0.007	0.008
1H	Moderate*	40.3	32.4	32.8	34.5	35.0	0.007	0.007
1A	Poor	38.9	39.6	22.8	35.4	34.0	0.009	0.015

* These holes were covered in spraying but subsequently opened in drying.

TABLE V

INFLUENCE OF DIFFERENT BALL CLAYS IN UNDERSLIPS ON THEIR ABILITY TO COVER OPEN CAVITIES

	Ball clay No.*	Percentage of holes covered	Thickness of dry underslip (in.)	
			Smooth portion	Near holes
1E	4	64.6	0.007	0.007
1C	2	50.6	0.008	0.011
1F	5	42.4	0.009	0.013
1G	7	40.2	0.007	0.012
1A	1	34.2	0.009	0.015

* Composition of underslip: English china clay 32.5, ball clay (varied for each underslip) 20.9, Cornwall stone 41.0, potter's flint 5.0, and soda ash 0.6%.

properties of the ball clays employed. In most cases the thickness of the sprayed underslip near the holes was found to be greater than that obtained on the smooth area, and this thickness near the holes was greatest for underslips of poor covering power. Upon firing to cone 04, it was found that the underslips changed little except that the cracks opened up somewhat.

(2) Underslips on Coal-Filled Cavities

After spraying underslips on coal-filled cavities and allowing them to dry, it was found that in many cases they tended to crack over the coal. Holes of large diameters were more difficult to cover than narrow, deep holes.

All underslips, except 1O and 1Q, showed some

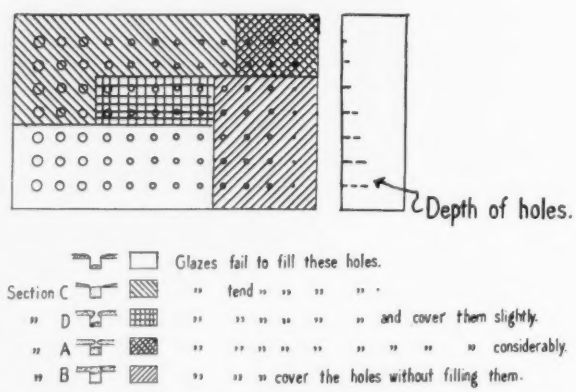
Depth of holes.
Glazes fail to fill these holes.
Section C " tend " " " " "
" D " " " " " " " and cover them slightly.
" A " " " " " " " " " considerably.
" B " " " cover the holes without filling them.

FIG. 2.—Tendency of glazes to fill and cover holes during spraying.

cracking over the coal-filled cavities upon drying, although the degree of cracking varied. Underslips 1F, 1G, and 1J showed little cracking; 1C, 1H, 1I, 1M, and 1N cracked appreciably; and

TABLE VI

TENDENCY OF SOME GLAZES TO FILL AND COVER OPEN CAVITIES DURING SPRAYING AND AFTER FIRING

		Section A Holes readily filled and covered Diam. 0.03 to 0.043 in. Depths 0.03 to 0.060 in.			Section B Holes readily covered Diam. 0.049 to 0.068 in. Depths 0.090 to 0.210 in.		
	Type of glaze	Percentage of holes covered (after drying)	(after firing)	Percentage remaining covered (after firing)	Percentage of holes covered (after drying)	(after firing)	Percentage remaining covered (after firing)
2J*	Lead-free borax zinc	100	83	83	80	25	31
2Y	Potash feldspar (semimat)	83	67	80	85	35	41
2F*	Lead-free alkali borax	66	66	100	40	10	25
2C*	Alkali lead borax	100	50	50	35	5	15
2T	Soda potash feldspar (bright glaze)	67	67	100	45	0	0
2L*	Lead borax	84	66	80	0	0	
2B*	Alkali lead borax	100	50	50	60	0	0
2K*	Leadless borax	100	66	66	5	0	0
2E*	Strontium borax	84	50	60	15	0	0
2M*	Lead borax	100	50	50	30	0	0
2O*	Leadless borax	100	50	50	35	0	0
2Q	Colemanite	83	50	60	35	25	71
2SA*	Lead bisilicate	67	50	75	40	20	50
2X	Potash feldspar (bright)	100	50	50	70	25	36
2Z	Potash feldspar (mat)	67	50	75	55	40	72
2N*	Lead borax	83	33	40	55	0	0
2V	Soda potash feldspar (mat)	50	33	67	0	0	
2G*	Lead-free lime borax	16	16	100	0	0	
2H	Raw lead	100	0	0	65	0	0

* Fritted.

		Section C Holes readily filled Diam. 0.049 to 0.135 in. Depths 0.036 to 0.09 in.			Section D Holes difficult to fill and cover Diam. 0.052 to 0.091 in. Depths 0.09 to 0.12 in.		
	Type of glaze	Percentage of holes filled (after drying)	(after firing)	Percentage remaining covered (after firing)	Percentage of holes covered (after drying)	(after firing)	Percentage remaining covered (after firing)
2J*	Lead-free borax zinc	46	46	100	0	0	
2Y	Potash feldspar (semimat)	0	0		0	0	
2F*	Lead-free alkali borax	0	0		0	0	
2C*	Alkali lead borax	83	54	82	80	0	0
2T	Soda potash feldspar (bright glaze)	0	0		0	0	
2L*	Lead borax	17	12	75	10	0	0
2B*	Alkali lead borax	25	3	12	0	0	
2K*	Leadless borax	0	0		0	0	
2E*	Strontium borax	0	0		0	0	
2M*	Lead borax	4	4	10	0	0	
2O*	Leadless borax	42	42	100	10	0	0
2Q	Colemanite	0	0		0	0	
2SA*	Lead bisilicate	0	0		0	0	
2X	Potash feldspar (bright)	29	29	100	0	0	
2Z	Potash feldspar (mat)	0	0		0	0	
2N*	Lead borax	25	4	17	0	0	
2V	Soda potash feldspar (mat)	0	0		10	0	0
2G*	Lead-free lime borax	0	0		0	0	
2H	Raw lead	12	0	0	20	0	0

* Fritted

1A, 1B, 1E, 1K, and 1L cracked badly. In general, cracking is related to shrinkage, although there are many exceptions. Underslips 1O and 1Q, which showed no cracks, have low shrinkage, while 1A, which has a higher shrinkage, cracked badly. On the other hand, 1F and 1G also have high shrinkage but developed only a few cracks.

Firing the cones 04 and 6 showed little change in the underslip, except that the cracks opened up in firing to the higher cone. A slight pressure was sufficient to break the shell of fired underslip, especially if this was thin or cracked. This revealed coal ash underneath, giving this defect the appearance of "pop-outs."

(3) Glazes on Open Cavities

The results of work on the ability of glazes to cover open cavities are given in Table VI and are

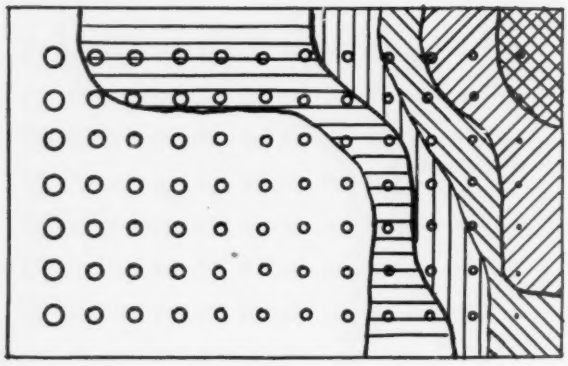

FIG. 3.—Tendency of glazes to fill and cover holes during spraying.

shown graphically in Figs. 2, 3, and 4. As would be expected, small shallow holes are most easily covered.

The properties of the frit evidently exert an important influence upon the ability of a glaze to fill and cover holes, which is shown by comparing the eight glazes containing 83.4 to 87.7% frit, namely, 2C, 2B, 2O, 2N, 2K, 2L, 2F, and 2G. Glaze 2C had good covering ability while 2G did not. (Although the mill batches are approximately the same, the chief difference is in the frits.) The compositions of the frits which gave the best results varied between the following limits: NaKO = 4.32 to 14.80%; CaO = 0 to 6.20%; BaO = 6.64 to 20%; ZnO = 13.23 to 20%; PbO = 17.01 to 18.23%; CaF_2 = 0 to 3.32%; B_2O_3 = 8.30 to 20%; Al_2O_3 = 0.83 to 8.58%; SiO_2 = 30 to 36.35%; and ZrO_2 = 0 to 8.30%.

Glaze 2J, which is a leadless fritted glaze, possessed the best covering power and contained only 37% frit. Glazes 2E and 2M, containing 91.4 to 94% frit, did not cover the large open cavities as well as many other glazes with a lower frit content.

The ability of a glaze to cover cavities after firing is, in general, closely related to its covering power during spraying, although there are exceptions to this rule. For example, 2H, which is a raw white lead glaze, had excellent covering power during spraying but, owing to its excessive firing

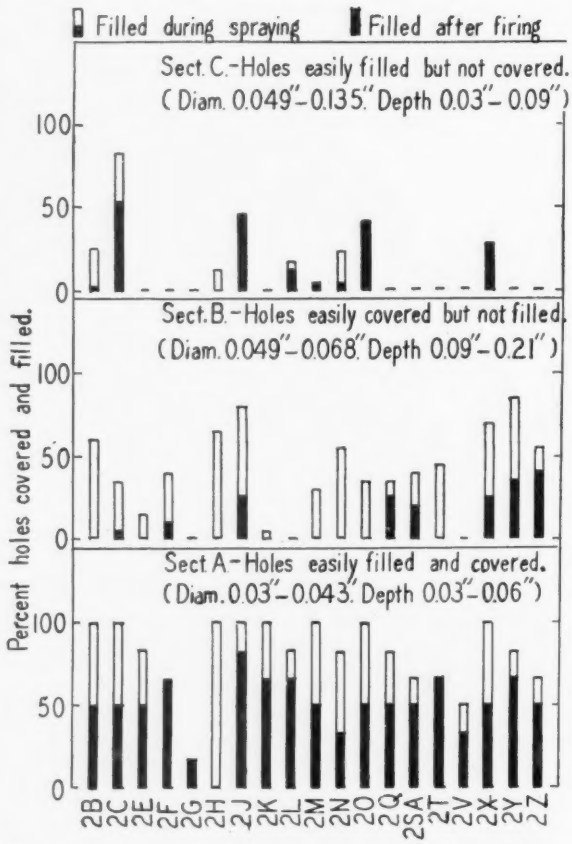
Filled during spraying
Filled after firing
Sect. C.–Holes easily filled but not covered.
(Diam. 0.049"–0.135" Depth 0.03"–0.09")
Sect. B.–Holes easily covered but not filled.
(Diam. 0.049"–0.068" Depth 0.09"–0.21")
Sect. A.–Holes easily filled and covered.
(Diam. 0.03"–0.043" Depth 0.03"–0.06")
Percent holes covered and filled.
100
50
0
2B 2C 2E 2F 2G 2H 2J 2K 2L 2M 2N 2O 2Q 2SA 2T 2V 2X 2Y 2Z

FIG. 4.—Percentage of holes filled and covered in spraying and firing.

shrinkage, it shrank from and exposed the body during firing (Fig. 4); 2SA, which has the same composition as 2H except that the lead is introduced as a frit, tested decidedly better; 2Q, which is a raw colemanite glaze, possessed good covering power. Of the cone 6 glazes, 2X and 2Y proved to be best.

(4) Glazes on Coal-Filled Cavities

The results of tests on the ability of glazes to cover coal-filled cavities are shown in Figs. 6 and 7. The typical behavior of such specimens during firing is illustrated in Fig. 5. Unlike underslips,

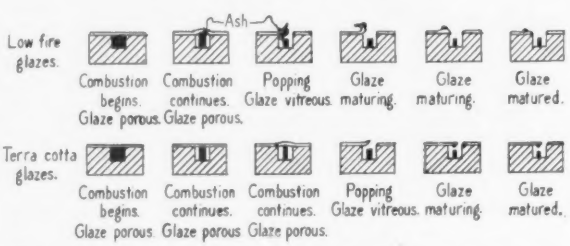

FIG. 5.—Kiln history showing development of glaze defects from coal underneath the glaze.

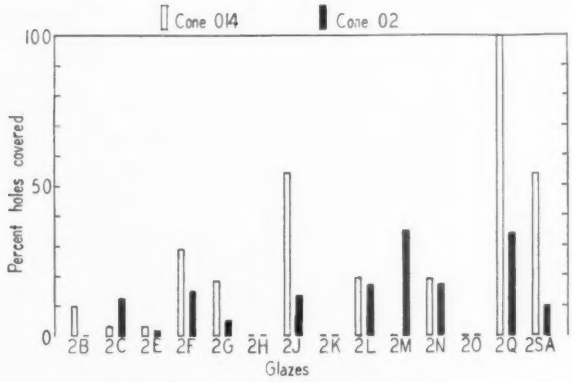

FIG. 6.—Percentage of coal-filled holes covered with glazes at different temperatures.

which usually formed a thin shell over the cavity left by coal, most of the glazes receded from the large coal particles exposing coal ash underneath.

Most glazes possessed better covering power at cone 014 than at cone 02, although glazes 2C and 2M tested better at the higher cone. Glazes 2C and 2M became very fluid at the higher temperatures and flowed into the cavities formed by the combustion of the coal particles. Glaze 2SA, which has the same composition as 2H except that the lead was introduced as a frit instead of raw white lead, again tested decidedly better than 2H. Glaze 2Q, a leadless glaze, possessed good covering power at both temperatures, probably because of its refractory nature. It is apparent, therefore, that extremely viscous glazes or exceedingly fluid glazes are the best to cover cavities caused by coal particles, while those with intermediate fluidity recede from these cavities and fail to cover them.

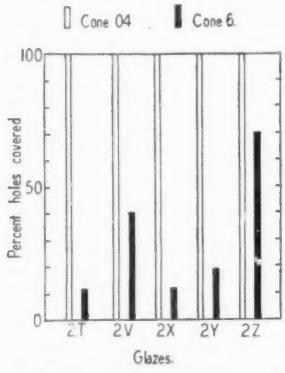

FIG. 7.—Percentage of coal-filled holes covered with terra cotta glazes.

In general, low-fire glazes were less capable of covering coal particles than cone 6 glazes. Mat and semi-mat glazes, 2Y, 2Z, and 2V, proved to be better than the full glazes, 2X and 2T (Fig. 7).

Particles of coal larger than 0.049 inch in diameter could not readily be covered with a glaze. Because a 14-mesh sieve has openings of 0.046 inch, it is evident that finer screens, at least 16- to 20-mesh, should be used for this type of work.

Some glazes, which fail to cover open cavities, also fall short of covering coal-filled holes, *e.g.*, glazes 2H, 2G, and 2B. Other glazes, however, which fail to cover coal particles, cover open cavities and *vice versa; e.g.*, glazes 2O, 2C, 2V, and 2M.

IV. Summary

(1) The ability of underslips or engobes to cover open cavities may vary widely according to the type and amount of plastic clay used. The available ball clays should be given a test, similar to that developed in this work, in order to select those with the best covering power.

(2) Glazes, as do underslips, vary considerably in their ability to cover open cavities, owing principally to the type and amounts of clay and frits employed and to their fluidity at furnace temperatures. The compositions of frits which gave the best results varied between the following limits: NaKO = 4.32 to 14.80%; CaO = 0 to 6.20%; BaO = 6.64 to 20%; ZnO = 13.23 to 20%; PbO = 17.01 to 18.23%; CaF_2 = 0 to 3.32%; B_2O_3 = 8.30 to 20%; Al_2O_3 = 0.83 to 8.58%; SiO_2 = 30 to 36.35%; and ZrO_2 = 0 to 8.30%.

(3) A glaze with 37% frit proved better than those with 83.4 to 94.0% frit.

(4) A raw white lead glaze had excellent covering power during spraying, but upon firing it shrank so much that it caused the glaze to crawl. Lead-fritted glazes, however, of the same composition, had good covering power. Such glazes are also practically nonpoisonous.

(5) Underslips, sprayed over surface coal particles, after firing may remain as a thin shell over cavities formed by the burning out of coal particles. These usually become broken in handling or in service, yielding small surface cavities with the appearance of popping.

(6) Viscous glazes cover but do not fill cavities left by the combustion of coal particles. Glazes of medium fluidity tend to recede from the cavities, failing to cover or fill them, while glazes of high fluidity tend both to fill and to cover these cavities.

(7) It is difficult to fill or cover cavities left by the combustion of coal particles 0.049 inch in diameter, even with the best glazes. Screening clays through at least a 16- or 20-mesh sieve is therefore recommended for clays containing combustible particles.

(8) Some glazes which fail to cover open cavities also fall short of covering cavities left by coal particles. Other glazes, however, which fail to cover cavities left by coal particles are effective in covering open cavities and *vice versa*.

Acknowledgment

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FLOW OF GLAZES ON HORIZONTAL AND INCLINED SURFACES*

By C. Major Lampman

Abstract

A method was developed for studying the flow of glazes on horizontal surfaces and this flow was compared with that on inclined surfaces at different temperatures. It was found that the flow of glazes on horizontal surfaces was not closely correlated to that on inclined surfaces. The flowing behavior of cones 014 to 03 and cone 6 glazes was studied during their melting process. Each glaze was found to have characteristic fluid properties not discernible on the ordinary sprayed trials. These tests are recommended as a refined control test for glazes. The churning effects of bubbles caused by blistering during the early stages of firing facilitate some glazes in spreading over and wetting the body. A glaze, high in clay, calcium oxide, and zinc oxide and low in barium carbonate, was found to possess desirable flow characteristics.

I. Introduction

It is often desirable to learn more about the fluid properties of glazes than is shown by the sprayed trials, especially when adopting new raw materials, developing new glazes, or correcting difficulties in old ones. Rieke and Tanne[1] conducted some tests on cones 12 to 18 porcelain glazes in which they measured their flow in inclined grooves. Because similar data were not available for brick and terra cotta glazes, corresponding tests were made with cones 014 to 03 and cone 6 glazes. Troughs made of raw clay six inches long, with a slight depression at the upper end to receive the disks of raw glaze were used (Fig. 1). The disks, which were $1\frac{1}{4}$ inches in diameter, weighed 10 grams and were made by dry pressing.

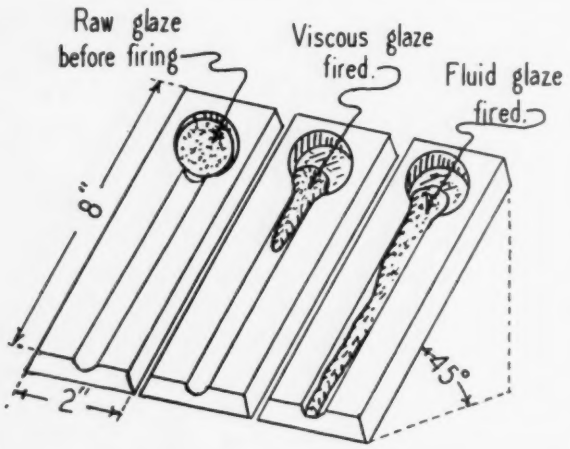

Fig. 1.—Method for comparing the viscosities of glazes at furnace temperatures.

Fig. 2.—Method for testing flow of glazes on horizontal surfaces (typical of glazes which do not blister).

The troughs were set at an angle of 45° during firing. After firing to different temperatures, the distances which the glazes flowed down the grooves were measured.

It is conceivable that surface tension is more effective in horizontal flow and viscosity in inclined flow. Thus horizontal and inclined flow may not be closely correlated. The test results seem

* Presented at the Thirty-Ninth Annual Meeting, American Ceramic Society, New York, N. Y., March 24, 1937 (White Wares Division). Received July 23, 1937.

[1] R. Rieke and C. Tanne, "Sintering and Melting Behavior of Porcelain Glazes," *Ber. deut. keram. Ges.*, **16**, 147–48 (1935); *Ceram. Abs.*, **14** [10] 252 (1935).

to confirm this lack of correlation.

For studying the horizontal flow of glazes, one-inch spheres weighing 16 grams were molded from the raw glaze and were set in the centers of raw unfired disks (Fig. 2). The diameters of the fused buttons, after firing to different temperatures, were taken as a measurement of the glaze flow. The analyses of feldspars and lead bisilicate are given in Table I.

The compositions of some of the glazes used are given in Table II and their empirical molecular formulas are shown in Tables III and IV. This work was done as a portion of a general program to develop glazes for red shale brick. It is not generally known which type of glaze is most suitable for this purpose. The study of low-fire glazes was, therefore, limited to typical glazes now in use or taken from literature. No attempt was made to vary their ingredients except by substituting potash for soda-potash feldspar in some glazes and by replacing raw white lead and flint with lead bisilicate frits in others. The effects of other variations will be studied with the most promising glazes. Typical bright, semimat, and mat terra cotta glazes were tested at cone 6.

TABLE I

CHEMICAL ANALYSES OF FELDSPARS AND ONE LEAD BISILICATE

	Potash feldspar	Soda-potash feldspar	Lead bisilicate
Silica	65.50	73.30	32.40
Alumina	18.50	16.00	2.40
Iron oxide	0.07	0.08	
Calcium oxide	0.30	0.97	
Magnesia	Trace	Trace	
Potash	13.70	5.03	
Soda	1.90	4.25	
Ignition loss	0.10	0.40	
Lead oxide			65.2

TABLE II

COMPOSITION OF CONE 6 GLAZES

	Soda-potash feldspar glazes			Potash feldspar glazes		
	2T	2U	2V	2X	2Y	2Z
Potash feldspar				40.50	37.60	42.00
Soda-potash feldspar	40.50	37.60	42.00			
Whiting	9.69	5.75	5.00	9.69	5.75	5.00
Zinc oxide	6.88	4.40	4.90	6.88	4.40	4.90
Steatite	1.69	1.95	5.00	1.69	1.95	5.00
Barium carbonate	4.94	11.90	12.60	4.94	11.90	12.60
Georgia kaolin	7.50	4.70	5.10	7.50	4.70	5.10
Flint	24.00	26.80	2.00	24.00	26.80	2.00
Opax	5.00	4.25	4.80	5.00	4.25	4.80

TABLE III

EMPIRICAL MOLECULAR FORMULAS OF CONES 014 TO 03 GLAZES

	$RO + R_2O = 1.00$							R_2O_3			$RO_2 + B_2O_3$			
No.	K_2O	Na_2O	CaO	MgO	BaO	SrO	ZnO	PbO	Al_2O_3	Fe_2O_3	SiO_2	B_2O_3	SnO_2	ZrO_2
2B	0.089	0.135	0.350					0.426	0.139		2.510	0.534	0.049	
2C	0.116	0.180	0.324					0.380	0.146		1.814	0.648	0.038	
2D	0.210	0.246			0.542				0.128		0.628	0.555	0.050	
2E	0.212	0.140				0.648			0.096		1.570	0.350	0.170	
2F	0.396	0.604							0.446		2.590		0.030	
2G	0.313	0.475	0.211						0.292		1.830	0.370	0.060	
2H	0.157	0.035	0.105	0.101			0.098	0.505	0.241		1.900		0.100	
2J	0.181	0.164	0.003		0.224		0.428		0.190		1.690	0.490	0.150	
2K	0.039	0.099	0.374				0.488		0.050		1.614			0.275
2L	0.060	0.091			0.224		0.428	0.197	0.041		1.507			0.260
2M	0.138	0.210						0.652	0.260		5.056	1.280		0.125
2N	0.097	0.147						0.756	0.039		1.012	0.590		0.082
2O	0.150	0.150			0.243		0.457		0.039		0.925	0.531		0.082
2P	0.120	0.027	0.527		0.143		0.183		0.162	0.001	1.660		0.109	
2Q	0.147	0.035	0.248		0.285		0.285		0.210	0.001	2.870	0.252	0.140	
2R	0.054	0.070	0.176	0.090			0.087	0.522	0.223	0.001	2.250		0.088	
2S	0.054	0.070	0.176	0.090			0.087	0.522	0.223	0.001	2.250		0.088	
2RA	0.135	0.030	0.159	0.086			0.085	0.506	0.250	0.001	2.060		0.085	
2SA	0.135	0.030	0.159	0.086			0.085	0.506	0.250	0.001	2.060		0.085	

TABLE IV

EMPIRICAL MOLECULAR FORMULAS OF CONE 6 GLAZES

	$RO + R_2O = 1.00$						R_2O_3		$RO_2 + B_2O_3$	
No.	K_2O	Na_2O	CaO	MgO	BaO	ZnO	Al_2O_3	Fe_2O_3	SiO_2	ZrO_2
2T	0.080	0.103	0.361	0.053	0.092	0.311	0.331	0.001	3.050	0.149
2U	0.084	0.107	0.264	0.069	0.253	0.223	0.319	0.001	3.980	0.143
2V	0.082	0.105	0.207	0.157	0.231	0.218	0.311	0.001	2.500	0.141
2X	0.192	0.043	0.339	0.050	0.086	0.290	0.356	0.001	3.150	0.139
2Y	0.208	0.046	0.232	0.066	0.240	0.212	0.345	0.001	3.590	0.134
2Z	0.200	0.045	0.180	0.148	0.220	0.207	0.337	0.001	2.190	0.135

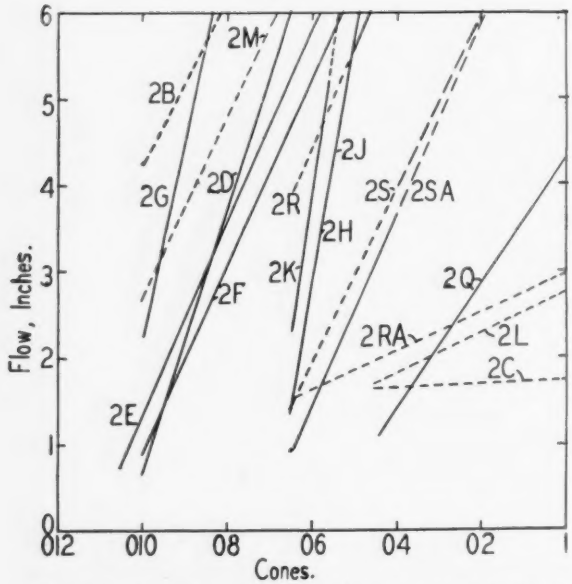

FIG. 3.—Flow of some low-fire glazes in trough inclined at 45°; *solid line*, matured; *long dashes*, slightly blistered; *short dashes*, badly blistered.

II. Results

The results of tests on the flow and other properties of low-fire glazes are plotted in Fig. 3. Some curves like 2D, 2E, and 2F have a gentle slope, while others have a steep slope. Glazes 2RA and 2L showed an increase in flow with increase in temperature, but they were blistered; glaze 2C, however, showed little flow and excessive blistering.

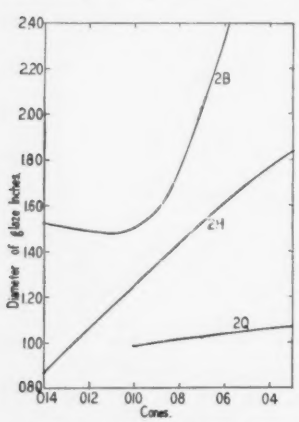

FIG. 4.—Flow of some low-fire glazes on a horizontal surface.

The results of flow of some of the low-fire glazes on horizontal surfaces are shown in Fig. 4. With some glazes, the flow increases rapidly with a rise in temperature, while in other cases it changes but slightly with an increase in temperature. Many low-fire glazes blister badly during the early stages of fire.

The results of flow of cone 6 glazes both on inclined and horizontal surfaces are given in Figs. 5 and 6.

III. Discussion of Results

(1) Inclined Flow of Low-Fire Glazes

It is obvious that low-fire glazes differ widely in their inclined flow. Some glazes like 2D, 2E, and 2F (Fig. 3) increase in flow with a rise in temperature to a lesser extent than others. These glazes can, therefore, be fired to a wide range of temperatures.

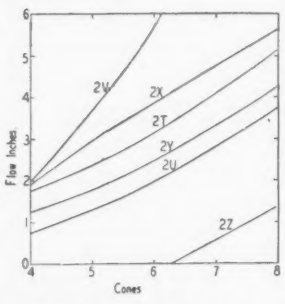

FIG. 5.—Flow of some terra cotta glazes in troughs inclined 45°.

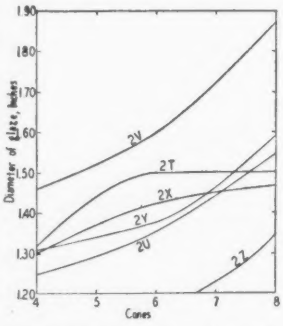

FIG. 6.—Flow of some terra cotta glazes on horizontal surface.

Three of the glazes (2H, 2RA, and 2SA) had approximately the same chemical analysis after firing except that the lead and silica were introduced in different forms. In glazes 2RA and 2SA, they were added as a frit, while in 2H they were introduced as raw white lead and flint. When the lead is introduced as a frit, it makes the glaze less fusible in some cases and also causes it to develop pinholes and blisters (Table V).

Although the potash feldspar contained 68.50% more total alkalis than the soda-potash feldspar glazes, those glazes containing the soda-potash feldspar were much more fluid than those with an equal weight of potash feldspar (Fig. 7). Soda-potash feldspar glazes were smoother, brighter, and blistered less than the potash feldspar glazes, and they should also decrease their tendency to craze.

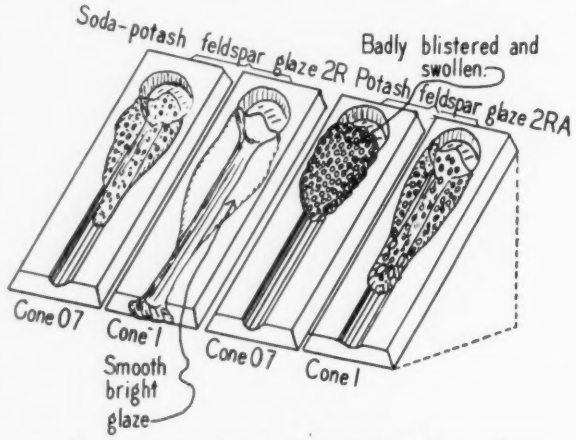

FIG. 7.—Behavior of soda and potash feldspar glazes.

TABLE V
EFFECT OF DIFFERENT FORMS OF LEAD AND FELDSPAR ON SOME PROPERTIES OF GLAZES

No.	Form in which lead was introduced	Cone 07			Cones 01–1		
		Flow (in.)	Gloss	Blistering	Flow (in.)	Gloss	Blistering
2SA*	Lead bisilicate No. 1	0.88	Mat	None	6.0+	Bright	Slight
2RA*	Lead bisilicate No. 2	1.50	Semimat	Bad	2.88	Semimat	Bad
2H*	White lead	1.38	Mat	None	6.0+	Bright	None
2S†		1.50	Semimat	Bad	6.0+	Bright	Slight
2R†		3.88	Semimat	Bad	6.0+	Bright	None

* Potash feldspar glazes.
† Soda-potash feldspar glazes.

Glazes 2B, 2M, 2R, 2S, 2RA, 2L, and 2C blistered badly and all of them contain a high lead oxide content, although 2H also has a high lead oxide content but did not blister. It is evident, therefore, that lead compounds may cause glazes to blister during firing.

(2) Horizontal Flow of Low-Fire Glazes

The horizontal flow of low-fire glazes in some cases remained practically constant for a wide range of temperatures (see 2B). With glaze 2H, the flow increased rapidly with a rise in temperature, while with glaze 2Q the flow did not change much. It is evident, therefore, that glazes have characteristic flow curves which may vary widely and that a study of these curves permits a selection of the safest glazes.

By observing the glaze spheres during firing, it was noticed that some low-fire glazes blistered badly during the early stages of firing but settled to a smooth glaze at the maturing temperatures.

The areas covered by these glazes were greater than those spread over by nonblistering glazes of the same maturing temperature. It is apparent, therefore, that the spreading power may be facilitated by bubbling during the early stages of firing. It is known that certain glazes cover surface cracks, while others with the same maturing temperatures do not. The fact that blistering may increase the spreading and wetting action of a glaze from agitation of the fluid glaze by bubbling may partly explain these phenomena.

(3) Inclined Flow of Cone 6 Glazes

It is evident that the inclined flow of cone 6 glazes increased less with a rise in temperature than it did for the low-fire glazes (Figs. 3 and 6). They did not blister as much as the low-fire glazes during the early stages of firing. This is probably due to the fact that they had not commenced to melt while the gases were being driven off as in the case with low-fire glazes.

It is again evident that soda-potash feldspar is a more powerful flux than potash feldspar; 2V, which contains soda-potash feldspar, showed greater fluidity, whereas 2Z, which contains an equal amount of potash feldspar, proved to be very viscous.

(4) Horizontal Flow of Cone 6 Glazes

The horizontal flow of glazes may be divided into two classes: (1) those in which the flow increases with rising temperatures as is the case with 2V, and (2) those in which the flow increases rapidly at low temperatures and then becomes relatively stationary at the higher heats. This is the case with glazes 2T and 2X. These glazes are comparatively high in clay, calcium oxide, and zinc oxide and are low in barium carbonate.

The flow of glazes on horizontal surfaces may be different from that on inclined surfaces. For example, at cone 8 the inclined flow of the glazes took the following order: 2V, 2X, 2T, 2Y, 2U, and 2Z; while at the same temperature, the horizontal flow of these glazes took the following order: 2V, 2Y, 2U, 2T, 2X, and 2Z. It is evident, therefore, that some glazes flowed relatively more on horizontal than on inclined surfaces and *vice versa*.

Any theory to explain these differences would have to consider surface tension, viscosity, body solution, and wetting ability of the glazes. It is possible that the surface tension and body solution are most pronounced in the horizontal flow, while viscosity is most important for the inclined flow.

Further differences between the inclined and horizontal flow are shown in Fig. 8. The curves are not parallel as would be the case if horizontal flow were closely related to inclined flow.

The horizontal flow should be as large as possible compared with the inclined flow, for in this case the thickness of the glaze would be more nearly the same on horizontal and vertical surfaces. It is desirable that this ratio be high. In general, glazes have a higher ratio at low than at high temperature. Some glazes like 2U and 2Y have a higher ratio than others at the average temperature (Fig. 9).

The importance of a closer study of the fluid properties of glazes in judging the proper maturing temperature of a glaze is apparent when it is

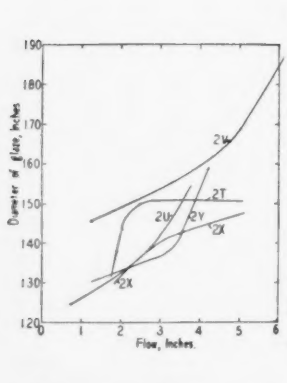

FIG. 8.—Relation between flow of glazes on horizontal surface to that on a 45° inclined surface.

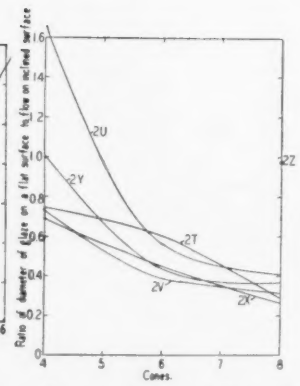

FIG. 9.—Ratio of flow of terra cotta glazes on horizontal surfaces to that on 45° inclined surfaces.

remembered that a glaze should be neither too viscous nor too fluid at the finishing temperature. Extremely viscous glazes may cause crawling, peeling, and shivering. Exceedingly fluid glazes may cause beading, discoloration, color variation, and crazing. A glaze which can be fired over the widest range of temperatures without becoming too viscous or too fluid would give the highest yield of first-quality ware with the large temperature variations commonly encountered in commercial kilns. These tests are, therefore, recommended as refined control tests of the glazes.

TABLE VI

RATIO OF FLOW OF TERRA COTTA GLAZES ON HORIZONTAL AND INCLINED SURFACES DURING FIRING

No.	Ratio of diameter of glaze on flat surface to flow on 45° inclined surface: Cone 4	Cone 6	Cone 8
2T	0.75	0.60	0.29
2U	1.66	0.56	0.41
2V	0.73	0.39	0.31
2X	0.69	0.46	0.26
2Y	1.05	0.44	0.37
2Z	0	0	0.97

IV. Summary

(1) A method was developed for studying the flow of glazes on horizontal surfaces. This flow was compared with inclined flow at different temperatures.

(2) It was found that horizontal flow is not always closely correlated to inclined flow.

(3) The flow characteristics of cones 014 to 03 and cone 6 glazes were studied during their melting process up to maturity.

(4) Glazes, claimed to have the same maturing temperatures as determined from sprayed trials, may possess widely different fluid properties at their finishing temperature. On inclined surfaces, the flow may increase at a uniformly rapid or slow rate with rising temperatures. In addition to these types of flow, that on horizontal surfaces may increase rapidly at low temperatures and change only slightly at high heats.

(5) Cones 014 to 03 glazes change more in fluidity with a rise in temperature than cone 6 glazes with a few exceptions.

(6) Some of the low-fire glazes blister at low temperatures which causes them to spread out over large areas. The agitation produced by bubbling assists the glazes in wetting bodies, and therefore may cause it to cover surface cracks and imperfections more efficiently. The importance of this bubbling to the adherence of glazes to bodies has not been sufficiently emphasized in the past.

(7) High lead glazes blistered badly in most cases.

(8) The replacement of raw lead and flint by lead bisilicate frit made the glazes more viscous.

(9) Substituting soda-potash feldspar for an equal weight of potash feldspar increased the fluidity and reduced blistering in most cases. The potash feldspar used in these cases was higher in total alkalis and alumina and lower in silica than the soda-potash feldspar.

(10) The use of a glaze low in barium carbonate and high in whiting and zinc oxide, in place of one high in barium carbonate and low in whiting and zinc oxide, improved the fluid properties of the glaze in one case.

(11) These tests are recommended as methods for determining the maturing range of glazes and also as control tests for new shipments of raw materials. They show differences between glazes not perceptible on the customary sprayed trials.

Acknowledgment

The author wishes to acknowledge the help of H. G. Schurecht, who suggested and directed this work, and of M. E. Holmes for helpful suggestions during its progress.

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CONVERSION TABLES FOR THERMAL UNITS*

Discussion of the Use of the Thermal Ohm as a Unit of Thermal Resistance

By Harold E. White

Ohm's law, in its application to electrical quantities, is familiar to everyone who has taken a course in physics. Its application to thermal problems is not so generally recognized.

The fault lies undoubtedly with the various investigators who use any number of different units to express their results.

In the able work on thermal conductivity fostered by the Refractories Division of the Society during the last three years, both C. G. S. and English units were used, not only in different papers but, in some cases, in the same paper.

To review this work, it is necessary to set up a conversion table and the attached tables, it is hoped, will be of assistance.

There will be a distinct advance in the understanding of the subject of thermal conduction if we can agree upon the use of a primary unit to express this relation. Carl Hering, some fifteen years ago, proposed the temporary use of the term, "thermal ohm," pending selection of a more permanent convention. Harper[1] proposed calling the metric unit of thermal resistance the "fourier" in honor of the foremost contributor to the theory of thermal conduction, and he defined the "fourier" as that resistance which will transfer heat energy at the rate of one watt (one joule per second) for each degree centigrade temperature difference between its terminal surfaces.

The thermal difference of potential is universally adopted in the degree Centigrade and Fahrenheit units.

The measure of rate of transfer of quantity of heat, corresponding to current in electrical parlance is not so well established. It happens that because of the extended areas through which heat transfer takes place in so many of the practical problems, it is much more usual to calculate in terms of heat flow per unit area than in terms of total heat flow. In Table II are collected ten of the units for density of energy transfer which are in most common use.

Modern physics is inseparably associated with the concept of heat as identical with energy, and the watt, as the unit for measuring rate of heat flow, is to be preferred over calories per second or kilocalories per hour, if not for simplicity alone, then for interchangeability between electrical and thermal energy and for ease in calculating efficiencies.

For heat-transfer work, let us then adopt the watt per square centimeter as the primary unit for heat flow per unit area.

For total heat flow, then, we can use watts per square centimeter per centimeter per degree Centigrade, which is the reciprocal of the thermal ohm and conversions can therefore readily be made (Table III).

It so happens that the thermal properties of the average brass one centimeter thick at room temperatures with a temperature difference of 1°C between faces has a heat flow of about 1 watt per square centimeter of area, so that its thermal resistance is one thermal ohm per square centimeter of cross-section.

Because silver and copper have about four times the thermal conductivity of brass, their resistance for the same section is one-fourth a thermal ohm.

While resistivity of a material involves linear dimensions of a unit specimen thereof, resistance does not involve these. That is, a thermal ohm is defined as the resistance which will allow one watt of energy to flow when a temperature gradient of one degree Centigrade is maintained and the user of the unit may combine it with feet or inches instead of centimeters in any computation.

For example, one thermal ohm·cm.$^{-2}$·cm. (or per in.$^{-2}$·in.) is equivalent to the number of °C necessary to pass one watt through 1 cm. per cm.^{2} area (or through 1 in. per in.^{2}).

Suppose a manufacturer tells you that his brick will pass 0.003 g.-cal.·sec.$^{-1}$·cm.$^{-2}$·cm.·°C^{-1}. Transpose this to thermal ohms cm.$^{-2}$·cm.

1°C will make 0.003 g.-cal. go through 1 cm.·sec.$^{-1}$·cm.$^{-2}$ area. In Table III, take the horizontal column headed "g.-cal.·sec.$^{-1}$·cm.$^{-2}$·cm.·°C^{-1}" and run across to the vertical line headed "watts cm.$^{-2}$·cm.·°C^{-1}," and you will find 4.186. Multiply 0.003 by 4.86 which gives 0.01256 watt·cm.$^{-2}$·cm.·°C^{-1}, the thermal conductivity of the brick.

It will then take 79.5°C to pass 1 watt through 1 centimeter square area 1 centimeter thick.

This is the resistivity of the brick in thermal ohms per square centimeter area per centimeter thickness.

For simple heat-loss calculations, a few equations may be used as follows:[2]

Where Q = quantity of heat per unit time
K = thermal conductivity
t = difference in temperature
S = surface area (outside)
s = surface area (inside)
l = thickness
d = diameter.

Equation for simple heat flow: $Q = \frac{Kt}{l} \cdot s.$

Cube: heat flow considering inner face and outer face as two cubes one inside the other[2] $Q = \frac{Kt}{l} \cdot \sqrt{Ss}.$

Cylinder: $Q = \frac{Kt}{l} \cdot \frac{S - s}{2.303 (\log S - \log s)}.$

The above equations are for simple calculations. For more accurate data, Glazebrook (Dictionary of Applied

* Received March 10, 1937.

[1] D. R. Harper, "Unit of Thermal Resistance; the 'Fourier' Hypotheses," *Jour. Wash. Acad. Sci.*, **18** [17] 459–71 (1928).

[2] (*a*) Carl Hering, "Heat Conductance through Walls of Furnaces," *Trans. Amer. Electrochem. Soc.*, **14**, 215 (1908). (*b*) Irving Langmuir, *ibid.*, **24**, 54 (1913).

TABLE I

CONVERSION FACTORS*

QUANTITATIVE ENERGY UNITS: THERMAL, ELECTRICAL, AND PHYSICAL

	Kg.-cal.	Kw.-hr.	B.t.u.	Hp.-hr.	Kg.-m.	Ft.-lb.	P.k.s.‡
1 kg.-cal.	1	0.001163	3.969	0.001559	426.9	3087.0	0.001581
1 kw.-hr.	860.0	1	3413.0	1.341	0.3671×10^{6}	0.2655×10^{7}	1.360
1 B.t.u.	0.2520	2.930×10^{-4}	1	3.929×10^{-4}	107.6	778.0	3.984×10^{-4}
1 hp.-hr.	641.3	0.7457	2545.0	1	0.2737×10^{6}	0.1980×10^{7}	1.014
1 kg.-m.	0.002343	2.724×10^{-6}	0.009297	3.653×10^{-6}	1	7.233	3.704×10^{-6}
1 ft.-lb.	3.239×10^{-4}	3.766×10^{-7}	0.001285	5.051×10^{-7}	0.1383	1	5.121×10^{-7}
1 p.k.s.‡	632.5	0.7355	2510.0	0.9863	0.2700×10^{6}	0.1953×10^{7}	1

* Based on I.C.T. Tables; mean values used for kg.-cal. and B.t.u.

‡ Metric horse-power hours (Pferde Kraft Stunden) = 735.5 watt-hr. at gravity 980.6. Standard Handbook for Electrical Engineers. McGraw-Hill Book Co., New York, 1931.

TABLE II

CONVERSION FACTORS*

UNITS OF DENSITY AND RATE OF ENERGY FLOW: THERMAL AND ELECTRICAL

	G.-cal. · sec.$^{-1}$ · cm.$^{-2}$	Kg.-cal. · hr.$^{-1}$ · m.$^{-2}$	Watt · cm.$^{-2}$	Watt · in.$^{-2}$	Kw. · ft.$^{-2}$	B.t.u. · hr.$^{-1}$ · ft.$^{-2}$	B.t.u. · hr.$^{-1}$ · in.$^{-2}$	B.t.u. · sec.$^{-1}$ · ft.$^{-2}$	B.t.u. · sec.$^{-1}$ · in.$^{-2}$	Hp. · ft.$^{-2}$
1 g.-cal. · sec.$^{-1}$ · cm.$^{-2}$	1	36,000.0	4.186	27.01	3.889	1.327×10^{4}	92.17	3.687	0.02560	5.215
1 kg.-cal. · hr.$^{-1}$ · m.$^{-2}$	2.778×10^{-5}	1	1.163×10^{-4}	7.502×10^{-4}	1.080×10^{-4}	0.3687	0.002560	1.024×10^{-4}	7.112×10^{-7}	1.449×10^{-4}
1 watt · cm.$^{-2}$	0.2389	8600.0	1	6.452	0.9290	3171.0	22.02	0.8808	0.006116	1.246
1 watt · in.$^{-2}$	0.03703	1333.0	0.1550	1	0.1440	491.5	3.413	0.1365	9.480×10^{-4}	0.1931
1 kw. · ft.$^{-2}$	0.2571	9257.0	1.076	6.944	1	3413.0	23.70	0.9480	0.006584	1.341
1 B.t.u. · hr.$^{-1}$ · ft.$^{-2}$	7.534×10^{-5}	2.712	3.154×10^{-4}	0.002035	2.930×10^{-4}	1	0.006944	2.778×10^{-4}	1.929×10^{-6}	3.929×10^{-4}
1 B.t.u. · hr.$^{-1}$ · in.$^{-2}$	0.01085	390.6	0.04542	0.2930	0.04219	144.0	1	0.04000	2.778×10^{-4}	0.05658
1 B.t.u. · sec.$^{-1}$ · ft.$^{-2}$	0.2712	9764.0	1.135	7.325	1.055	3600.0	25	1	0.006944	1.415
1 B.t.u. · sec.$^{-1}$ · in.$^{-2}$	39.06	1.406×10^{6}	163.5	1055.0	151.9	51.84×10^{4}	3600.0	144.0	1	203.7
1 hp. · ft.$^{-2}$	0.1917	6903.0	0.8027	5.178	0.7457	2545.0	17.67	0.7070	0.004909	1

* Based on I.C.T. Tables; mean values used for kg.-cal. and B.t.u.

TABLE III

CONVERSION FACTORS*

UNITS OF CONDUCTANCE OF ENERGY: THERMAL AND ELECTRICAL.

	G.-cal. · sec.$^{-1}$ · cm.$^{-2}$ · cm. · °C^{-1}	Kg.-cal. · hr.$^{-1}$ · cm.$^{-2}$ · cm. · °C^{-1}	Watt · cm.$^{-2}$ · cm. · °C^{-1}	Watt · in.$^{-2}$ · in. · °C^{-1}	Kw. · ft.$^{-2}$ · in. · °C^{-1}	Kw. · ft.$^{-2}$ · in. · °F^{-1}	B.t.u. · hr.$^{-1}$ · in.$^{-2}$ · in. · °F^{-1}	B.t.u. · hr.$^{-1}$ · ft.$^{-2}$ · ft. · °F^{-1}	B.t.u. · hr.$^{-1}$ · ft.$^{-2}$ · in. · °C^{-1}
1 g.-cal. · sec.$^{-1}$ · cm.$^{-2}$ · cm. · °C^{-1}	1	3.600	4.186	10.63	1.531	0.8506	20.16	2903	241.9	5225.8
1 kg.-cal. · hr.$^{-1}$ · cm.$^{-2}$ · cm. · °C^{-1}	0.2778	1	1.163	2.953	0.4253	0.2363	5.600	806.4	67.20	1452
1 watt · cm.$^{-2}$ · cm. · °C^{-1}	0.2389	0.8600	1	2.540	0.3658	0.2032	4.816	693.5	57.79	1248
1 watt · in.$^{-2}$ · in. · °C^{-1}	0.09405	0.3386	0.3937	1	0.1440	0.08000	1.896	273.0	22.75	491.5
1 kw. · ft.$^{-2}$ · in. · °C^{-1}	0.6531	2.351	2.734	6.944	1	0.5556	13.17	1896	158.0	3413
1 kw. · ft.$^{-2}$ · in. · °F^{-1}	1.176	4.232	4.921	12.50	1.800	1	23.70	3413	284.4	6143
1 B.t.u. · hr.$^{-1}$ · in.$^{-2}$ · in. · °F^{-1}	0.04960	0.1786	0.2076	0.5274	0.07595	0.04219	1	144.0	12.00	259.2
1 B.t.u. · hr.$^{-1}$ · ft.$^{-2}$ · in. · °F^{-1}	3.445×10^{-4}	0.001240	0.001442	0.003663	5.274×10^{-4}	2.930×10^{-4}	0.006944	1	0.08333	1.800
1 B.t.u. · hr.$^{-1}$ · ft.$^{-2}$ · ft.$^{-2}$ · ft. · °F^{-1}	0.004134	0.01488	0.01730	0.04395	0.006329	0.003516	0.08333	12.00	1	21.60
1 B.t.u. · hr.$^{-1}$ · ft.$^{-2}$ · in. · °C^{-1}	1.914×10^{-4}	6.889×10^{-4}	8.011×10^{-4}	0.002035	2.930×10^{-4}	1.628	0.003858	0.5556	0.04630	1

* Based on I.C.T. Tables; mean values used for kg.-cal. and B.t.u.

Physics, Vol. 1, p. 463 (1922)) gives the equation for the heat flow of two cubes, one inside the other, as

$$Q = Kt\left(\frac{s}{L} + 0.54\,(a + b + c) + 1.2L\right)$$

Where s = area of inner surface
a, b, and c = inner dimensions and are $> 1/5L$, which is the most general case
L = thickness.

The simplest formula given by Glazebrook is

$$Q = Kt \cdot 0.79\,\frac{\sqrt{Ss}}{L}$$

for the condition of the three dimensions $<1/5\,t$. This differs from Hering's equation by the correction factor 0.79, which may be too large.

Glazebrook gives the equation for a spherical shell as

$$Q = Kt\,\frac{2\pi ab}{b - a}$$

Where a = inner diameter
b = outer diameter.

For two cylinders, one inside another

$$Q = \frac{Kt\,2.73\,L}{\log_{10}\left(\frac{b}{a}\right)}$$

Where L = length of cylinder
a = inner diameter
b = outer diameter.

The following factors may be used to convert from thermal ohms cm.$^{-2}$·cm. to the usual conventional units:

1g.-cal.·sec.$^{-1}$·cm.$^{-2}$·cm.·°C^{-1} = 4.186(reciprocal thermal ohms)
Kg.-cal.·hr.$^{-1}$·cm.$^{-2}$·cm.·°C^{-1} = 1.163
Watts·cm.$^{-2}$·cm.·°C^{-1} = 1
Watts·in.$^{-2}$·in.·°C^{-1} = 0.3937
Kw.·ft.$^{-2}$·in.·°C^{-1} = 2.734
Kw.·ft.$^{-2}$·in.·°F^{-1} = 4.921
B.t.u.·hr.$^{-1}$·in.$^{-2}$·in.·°F^{-1} = 0.2076
B.t.u.·hr.$^{-1}$·ft.$^{-2}$·in.·°F^{-1} = 0.001442
B.t.u.·hr.$^{-1}$·ft.$^{-2}$·ft.·°F^{-1} = 0.01730
B.t.u.·hr.$^{-1}$·ft.$^{-2}$·in.·°C^{-1} = 8.011×10^{-4}
B.t.u.·hr.$^{-1}$·in.$^{-2}$·in.·°C^{-1} = 0.115
B.t.u.·sec.$^{-1}$·in.$^{-2}$·in.·°F^{-1} = 747.4
B.t.u.·sec.$^{-1}$·in.$^{-2}$·in.·°C^{-1} = 415
Hp·ft.$^{-2}$·ft.·°F^{-1} = 44.03
Hp·ft.$^{-2}$·in.·°F^{-1} = 3.66

APPROXIMATE THERMAL RESISTIVITIES EXPRESSED IN THERMAL OHMS
(cm.$^{-2}$·cm.)

Silver	0.239
Copper	0.258
Aluminum	0.49
Brass (30% Zn)	0.93
Iron	1.6
Nickel	1.7
Steel	2.1
Glass*	133
Concrete*	140
Mica* ⊥ laminations	200
Fire brick* (25°–1000°C)	90–116
Asbestos	1100
Cork	2000
Magnesite brick*	56 (600°C)
Chrome brick*	73 (600°C)
Silica brick*	82 (600°C)
Silicon carbide brick*	24–27 (600°C)

* Variable on different grades. At 20°C unless otherwise specified.

The adoption of the use of the term, "thermal ohm," is therefore suggested to be defined as follows:

A thermal ohm is a unit of thermal resistance which will allow one watt of heat energy to flow through one square centimeter of substance of one centimeter thickness under a thermal gradient of one degree centigrade.

Acknowledgment

The assistance of R. F. Ferguson, J. B. Austin, C. F. Lucks, and J. D. Sullivan in checking these tables and offering helpful suggestions is gratefully acknowledged.

Where? When?

40th ANNUAL MEETING

NEW ORLEANS

MARCH 27–APRIL 2

AMERICAN CERAMIC SOCIETY, INCORPORATED

2525 N. HIGH STREET, COLUMBUS, OHIO

THE PRESIDENT'S PAGE

SPEED

Some years ago, along with many another reader, I smiled with indulgent superiority at a quotation from the proceedings of a minor religious sect in southern Ohio. It was a resolution adopted at a meeting held just about one hundred years ago. After considering the advantages and disadvantages of the proposed railroad that was to cross the State and connect Cincinnati with the East, the meeting voted its conviction that "God did not intend his creatures to travel at the frightful pace of thirty miles an hour."

Since then, the smile has been gradually shifting to the other side of the face. In spite of safety campaigns, safety devices, patrols, and warnings, the number of serious and fatal traffic accidents continues to rise with the relentless impartiality of the death-rate in a major epidemic. I became particularly thoughtful when, upon being elected a member of the Board of Trustees of the American Ceramic Society, I reflected that out of the fourteen members of that sober and cautious body, four had recently been through automobile crashes that sent them to the hospital for periods varying from one week to one year. What if the Dunkards were right?

If only we were automatons or robots, there would be no difficulty. It would not be hard to show, by means of the mathematics of the kinetic theory of gases, that the faster we went with our eyes shut, the fewer crashes we would have. Unfortunately, we insist on exercising judgment and using logic and reason. These things take time, even if it is measured only in fractions of a second. The conversion of these judgments into mechanical action also takes time, even though only a few thousandths of a second. The summation is long enough and unpredictable enough to vitiate completely the kinetic theory.

What has all this to do with ceramics? Just this: there are chemical reactions that are just naturally, in human terms, slow, and the ceramic industries come near having a monopoly of them. It must recognize the fact.

The human mechanism depends upon a set of reactions, physiological, psychological, and psychic, that were determined hundreds of thousands of years before high-speed vehicles were thought of. The speed of most of these reactions is not perceptibly affected by preaching or teaching, by threats or rewards. We will not solve the traffic problem until this is clearly understood.

Nor will we turn out ceramic profits any faster by ignoring the fact that silicate reactions are slow reactions. Quartz can be heated for many minutes, possibly even for hours, at a temperature above its melting point, without showing the least sign of melting. Vitreous silica, completely unstable at all temperatures below 1728°C, can be heated for days at a bright red heat without crystallizing. The alkali feldspars not only melt slowly, but remain rigid solids even though liquid in the thermodynamic sense. Silica is conspicuous for its ability to form compounds and solutions that in the liquid state flow with extreme slowness; diffusion into them and reactions within them are correspondingly slow.

Attempts to speed up the processes dependent upon these reactions are consequently futile. Silica brick in which the quartz-cristobalite inversion has been hastened by rapid heating or by catalysts is of lower quality than brick made by the customary long-time firing. Overglaze decorations, fired so rapidly to meet sales schedules that they have had no time to diffuse and react in the silicate liquid, wash off and give a bad name to the ceramic products of the country of their origin. Enamels and glazes, not kept hot long enough to complete the necessary surface reactions or to anneal out the resultant strain, chip and craze. Glassware, of every value from bottles to telescopic lenses, not permitted the time at high temperature for the necessary internal readjustment of equilibrium, shatters or is too inhomogeneous to be useful.

But, you will say, other industries have speeded up their processes, sometimes a hundredfold. True, but in most instances they were working with intrinsically rapid reactions, which needed only to be released with the aid of better contact, higher temperature, or more active solvents. Catalytic agents have sometimes come to the rescue, and there are possibilities not yet explored in the use of catalysts in silicate reactions, but don't make the mistake of asking the administrative and accounting departments to supply them; they will be the result only of patient physicochemical research and ceramic experimentation. And in the long run it will still be true that sluggishness is the word for most silicate reactions. The rising industrialist who is ambitious to found another Nobel fortune by speeding up his processes can be safely advised to avoid ceramics and stick to dynamite.

—ROBERT B. SOSMAN

All You Can Do by and through This Society, You Do for *Yourself and Fellow Ceramists*

Distinguished 1937 Service Record Is Now History

How about 1938?

Paid Members 1945

Paid Subscribers 523

Prepaid Circulation 2468

Sales from Stock 220

Total Circulation 2688

To this number of interested persons, the American Ceramic Society sends three publications each month, (1) *Journal*, (2) *Ceramic Abstracts*, and (3) *The Bulletin*.

In 1937, the Society published in the *Journal* a total of 404 pages; in *Ceramic Abstracts*, 436 pages; and in *The Bulletin*, 504 pages; together these serve as working tools for promoting ceramic arts, science, and technology.

1937 MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
January 20, 1937	1478	199				
February 23, 1937	1579	210	19	515	220	2543
March 29, 1937	1613	212	18	524	220	2587
April 23, 1937	1517	209	29	485	220	2460
May 22, 1937	1541	209	25	501	220	2496
June 22, 1937	1572	211	23	502	220	2528
July 20, 1937	1607	212	20	506	220	2565
August 23, 1937	1634	215	17	509	220	2595
September 23, 1937	1647	217	19	509	220	2612
October 23, 1937	1681	218	16	512	220	2647
November 19, 1937	1694	219	13	512	220	2658
December 22, 1937	1713	220	12	523	220	2688

How about 1938?

ROSTER CHANGES DURING DECEMBER*

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ARKETEX CERAMIC CORP., Attn. George Shoemaker, Brazil, Ind. (formerly the Clay Products Co., Inc., of Indiana)

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BRAY, KENNETH J., 1921 Wayland Ave., Norwood, Ohio. (Indianapolis, Ind.)

COFFEEN, WILLIAM W., Canton Stamping & Enameling Co., Canton, Ohio. (Champaign, Ill.)

DUBOIS, H. B., Consolidated Feldspar Corp., Trenton Trust Bldg., Trenton, N. J. (East Liverpool, Ohio)

FRAUTSCHI, ROBERT F., Owens-Illinois Glass Co., ACL Dept., Toledo, Ohio. (Alton, Ill.)

HARTH, P. E., 712 Audubon Drive, Clayton, Mo. (St. Louis, Mo.)

HATCH, EDWIN F., Y. M. C. A., Pawtucket, R. I. (Clarksburg, W. Va.)

KELLER, LEWIS H., Owens-Illinois Glass Co., Streator, Ill. (Fairmont, W. Va.)

KERR, CHARLES H., 1020 LeRoy St., San Diego, Calif. (La Jolla, Calif.)

KORA, YOSHIO, Kurosaki Yogyo K. K., Yahata, Fukuoka-ken, Japan. (Columbus, Ohio)

MALINOSKY, A., JR., Bridgeport, Calif. (Huntington Park, Calif.)

MORGAN, WILLARD L., 72 Massasoit Ave., Cranston, Providence, R. I. (Calumet City, Ill.)

PHILLIPSON, E. G., Box 144, Medicine Hat, Alberta, Canada. (Regina, Sask., Canada)

ROBERTS, JOHN T., 2111 Grove Ave., Berwyn, Ill. (Chicago, Ill.)

SIXT, LAWRENCE F., 3100 N. Grand Blvd., St. Louis, Mo. (Buffalo, N. Y.)

STEPHENSON, S. R., P. O. Box 1192, Birmingham, Ala. (Listed in place of Gordon Massengale, Cordova, Ala.)

TARNOPOL, MILTON S., Battelle Memorial Institute, 505 King Ave., Columbus, Ohio. (Zanesville, Ohio)

TYRRELL, MILES E., 1121 West 21, Erie, Pa. (Rolla, Mo.)

* Address in parentheses is the former address.

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COOPER, MAURICE A., University of Witwatersrand, Johannesburg, South Africa; consultant.

DECKER, ALFRED R., Champion Spark Plug Co., 8525 Butler Avenue, Detroit, Mich.

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*SIEGRIST, PAUL F., 412 Perkins St., Alcoa, Tenn.; Alcoa Brick Co.

WISEMAN, CLAUDE F., Box 495, Charleston, W. Va.; ceramist, West Virginia Brick Co.

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BUCK, IVAN, Pennsylvania State College.

GREENE, KENNETH T., Rutgers University.

HUEBNER, RICHARD H., Ohio State University.

MOORE, JOHN G., University of Illinois.

PEER, SIDNEY A., Missouri School of Mines.

PROE, JOSEPH A., JR., New York State College of Ceramics.

RICHARDSON, CHARLOTTE B., Western College of Education, Bellingham, Wash.

SHEAROUSE, LEE, Georgia School of Technology.

SMITH, DONALD I., Pennsylvania State College.

WOODRUFF, ROBERT W., New York State College of Ceramics.

WRIGHT, GEORGE A., Georgia School of Technology.

ZINSZER, W. K., University of Alabama.

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P. W. Hager	1	J. M. Stangl	1
L. C. Hewitt	1	C. Forrest Tefft	1
Ellis Lovejoy	1	Office	5

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A. E. Baggs	1	M. E. Holmes	2
C. M. Dodd	1	T. N. McVay	1
George Faust	1	Lane Mitchell	3
M. E. Green	1	N. W. Taylor	1
		Grand Total	**30**

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J. M. MCKINLEY, North American Refractories Co., Cleveland, Ohio

Permanent Committee on Simplification of Sizes and Varieties of Vitrified Paving Brick

O. W. RENKERT, Metropolitan Paving Brick Co., Canton, Ohio

Committee on Dust Hazard (temporary)

F. C. FLINT, *Chairman:* Hazel-Atlas Glass Co., Zanesville, Ohio

EDWARD SCHRAMM, Onondaga Pottery Co., Syracuse, N. Y.

J. C. HOSTETTER, Hartford-Empire Co., Hartford, Conn.

L. H. MILLIGAN, Norton Company, Worcester, Mass.

Forward-going aggressive ceramists succeed only by continually studying, not narrowly, but broadly the current problems in all ceramic fields.

NORTHERN CALIFORNIA SECTION ORGANIZED

Organization Committee

At the time of the visit of Ross C. Purdy, General Secretary of the American Ceramic Society, to San Francisco, at a meeting held here in January, 1937, it was proposed to form the Northern California Section, and to this purpose a committee was appointed. Subsequently a petition for the organization of such a chapter was submitted to the American Ceramic Society at Columbus, Ohio. The Board of Trustees of the American Ceramic Society granted the charter to the Northern California Section on September 12, 1937.

A call was extended to all interested to attend a meeting to be held on December 6, 1937, at the Hotel Whitcomb, 1231 Market Street, San Francisco, for the purpose of organizing the Northern California Section of the American Ceramic Society and to elect officers for the ensuing year. The meeting was preceded by a dinner at 7:00 P.M.

Thomas Stanley Curtis of Los Angeles, California, who is well known to the ceramic industry, kindly agreed to come to San Francisco to assist in the organization of this chapter. Dr. Curtis was the founder of the Southern California Section of the American Ceramic Society and has been active in that Section ever since; his experience in organizing this new Section, together with his counsel and advice, was invaluable. Dr. Curtis also gave a talk on the "Progress of the Ceramic Industry" and upon the opportunities that exist for it in the future.

There are a great many individuals in this part of the country who are interested in the formation of the Northern California Section.

The members of the Committee for the organization of the Section were Byron B. Josi, Owens-Illinois Pacific Coast Co.; E. E. Saunders, Gladding, McBean & Co.; L. G. Wassman, Standard Sanitary Mfg. Co.; Willi M. Cohn, Consulting Physicist; and George A. Page, Stockton Fire Brick Co.

Forty-five persons, including personnel from various plants, ceramic artists, and educators in this vicinity, attended the organization meeting of this Section. In the absence of a formal section, the writer served as chairman and outlined the progress that had been made in an effort to organize a local section in this district.

W. L. Fabianic, a member of the St. Louis Section, explained the operation of his Section, and he expressed the need of a section in this particular vicinity.

Wendl A. Mahaffy, a former member of the Pittsburgh Section, and E. E. Saunders, formerly of the Pacific-Northwest Section, were also present and spoke of the work of these Sections.

A motion was made and unanimously passed that a local section be formulated, and the following officers were elected for a term to continue to January 1, 1939:

Chairman: Clare S. Chaffee, Owens-Illinois Pacific Coast Co., San Francisco, Calif.

Vice-Chairman: Albert S. Adcock, Standard Sanitary Mfg. Co., Richmond, Calif.

Treasurer: Wendl A. Mahaffy, Owens-Illinois Pacific Coast Co., San Francisco, Calif.

Secretary: George A. Page, Stockton Fire Brick Co.; Pittsburgh, Calif.

A general discussion followed relative to dues, procedure of the various sections, and time of meeting. It was decided that the meeting period of the Northern California Section of the American Ceramic Society be once every two months.

From the enthusiasm registered at this initial meeting, the indications are that Northern California will have a very "live-wire" Section.

—GEORGE A. PAGE, *Secretary*

STRUCTURAL CLAY PRODUCTS NOMINATIONS

The nominating committee of the Structural Clay Products Division has announced the following men for officers of the Division:

Chairman: T. W. Garve, 314 King Ave., Columbus, Ohio.

Vice-Chairman: E. C. Clemens, Cannelton Sewer Pipe Co., Cannelton, Ind.

Secretary: H. Z. Schofield, O. S. U. Engineering Expt. Station, Columbus, Ohio.

DONALD ROSS, "OLD KING COLE"

Donald Ross recently has taken a position with the Laclede-Christy Clay Products Co., St. Louis, Mo. Mr. Ross was graduated from the University of Washington with a B.S. degree in Chemical Engineering in 1910. While there he received the T. T. Kerl Award. He was made a member of Phi Lambda Upsilon.

After graduation, he was connected with Denny Renton Coal and Clay Co., Seattle, Wash. He then spent four years with the National Bureau of Standards on ceramic work under the direction of A. V. Bleininger. This was followed by a position as Director of Research of Findlay Clay Products Co., Washington, Pa., from January, 1918, to May, 1936. From May, 1936, to October 1, 1937, he was engaged in some private development and as a consulting ceramist, and since October 1, 1937, he has been located in St. Louis with the Laclede-Christy Clay Products Co.

SOUTHERN CALIFORNIA SECTION

Members of the Southern California Section enjoyed a meeting on November 29, 1937, at the Hotel Mayfair, Los Angeles, Calif.

The purpose of this meeting was to bring together the old and new members in a strictly informal way where ideas were exchanged, new friends made, the usual old chestnuts told, and a "helluva" good time was had by all. A deluxe floor show presented with the compliments of the ceramic materials supply houses, afforded the entertainment.

The officers of this Division are as follows: *Chairman*, E. L. Maxson; *Secretary-Treasurer*, H. R. Goodrich; and *Permanent Secretary*, T. S. Curtis.

MISSOURI SCHOOL OF MINES AND METALLURGY

On November 23, 1937, the students of the Ceramic Department at the Missouri School of Mines and Metallurgy, Rolla, Mo., voted to change the name of their student organization from the Orton Society to the Student Branch of The American Ceramic Society. The newly-elected officers are *President*, Albert Tetley; *Vice-President*, Sidney Peer; *Secretary-Treasurer*, Theodore Planje.

—C. M. Dodd.

PRESIDENT SOSMAN SUGGESTS NEW BULLETIN DEPARTMENT*

Have you ever considered the policy of providing a page or two for "Letters to the Editor"? Most magazines nowadays call upon their readers in this way and it apparently helps in instruction, entertainment, and circulation. We should be able to secure two or three letters a month from our members without trying very hard.

Letters such as those you have received during the past year from Charter Members would be particularly interesting to have in print, but we would also expect to have contributions on controversial subjects. I believe it would stimulate interest in our publications.

Editor's Note: The Editor will be pleased to act on this suggestion and requests members to coöperate by sending such correspondence to the Secretary's office, 2525 North High Street, Columbus, Ohio.

"PAN-HANDLING RACKET"

Editor's Note: The following letter was written by L. J. Trostel, General Refractories Co., Baltimore, Md., to C. Forrest Tefft, of The Claycraft Co., Columbus, Ohio. There have been a number of reports reaching the Secretary's office of this racket. Others who have reported visits by the same man are C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio; W. C. Rueckel, Koppers Construction Co., Pittsburgh, Pa.; and Kenneth Buck, Ross-Tacony Crucible Co., Philadelphia, Pa. In each case the stories have been similar.

"I was visited a day or so ago by a man whom I suspect is running a 'pan-handling racket,' and in the course of his conversation claimed to be well acquainted with you, had visited you recently, and that you both had discussed me.

"His story did not sound at all plausible to me and I thought you might be interested to know more about this man. His description is as follows: 5 feet 5 inches tall, of rather stocky build, weighing about 160 pounds, dark hair slightly grayed, a ruddy complexion, about 45 or 50 years old. He gave his name as Boyd.

"I believe this man fits the description of an individual described in a recent *American Refractories Institute Bulletin* which follows."

One of our members reports a "racket" that has been going on for some time in the refractories industry, and we pass along the information as it comes to us so that you are not taken unaware by this person's tactics.

It seems that a so-called ceramic engineer has been making a tour of refractories plants, claiming to be a graduate of certain ceramic universities, the schools varying with the locality. This person asks for work for a few days so that he can earn enough money to buy food or transportation to some other town, etc. If the plant does not have a job he then asks for a loan, or to have a check cashed or the like. He has quite a lot of information relative to personnel and operating details of a large number of plants and therefore tells a plausible story.

We understand that this man is now starting to work the sales offices of refractories companies and that recently he was in Pennsylvania and is now in New York City.

We do not have a description of the man's appearance, but from the above information, you may be able to spot the man should he come to you with his story.

"If the ceramic people around Columbus are not already aware of the operations of this man, it will probably be doing them a service to pass the word around."

—C. Forrest Tefft

LETTER FROM MRS. J. W. DIXON

Mrs. J. W. Dixon, of Burlington, Iowa, is curator of pottery, porcelain, and glass in the Department of Fine Arts Section of the Iowa Federation of Women's Clubs. For a number of years Mrs. Dixon has been in communication with the Secretary of the American Ceramic Society, and she has done excellent work in promoting interest and information concerning American-made pottery, glass, and china. Mrs. Dixon writes of her membership as follows:

Value of Society Membership

"Membership in your distinguished Society has proved a great advantage to me educationally this past year, and I am sure has been a solid factor in the fine response from manufacturers when, this last summer, it was proposed to them that new and finer features be loaned to the American Pottery and Porcelain Exhibit, retiring former articles unless they carried some particularly unique technical point. Every two years, since its opening in 1931, this Exhibit has been reorganized, reduced in quantity, improved in quality, but it has never been so beautiful or so rich in information as this season.

"The exhibits for this season are the combined pottery and porcelain, the American glass, a handsome Spode service (thirty-seven plates, personally selected by Sidney Thompson), and a 4-reel film showing all types of work in the old Spode Pottery. The Exhibit has an excellent booking and bids fair to equal the enthusiastic reception of the past two-year administration closed last May, which recorded an attendance of 52,000 club women and their guests during that period.

Stained Glass Booklet

"I am now working out a two-volume loose-leaf service on stained glass in America, with fine contributions in articles and pictures by the D'Ascenzo Studios, Lawrence Saint, etc. This is to be rented out to clubs on a four-week period service, allowing time for two lessons, the fee one dollar and payment of expressage to and fro on the books.

"So many clubs have expressed the need for information. These clubs could not possibly have handled successfully the elaborate stained-glass exhibits of the past two seasons, and I have hoped this form of study might fill the requests

* Letter from R. B. Sosman, President of the Society. Received November 10, 1937.

of those who have meager library facilities in their home towns. Richard F. Bach of the Metropolitan Museum assures me there is nothing published on stained glass in America anyway, except for the 'trickles of information' in the magazines, so this should not come amiss for the average small town."

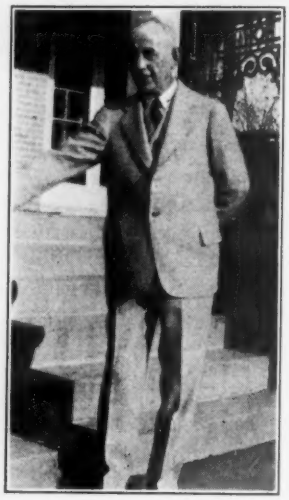
EDITOR'S NOTE: On page 32, Mrs. Dixon writes of her eagerness to attend the New Orleans Meeting.

NECROLOGY

D. E. McNICOL, JR.

D. E. McNicol, aged forty-seven, died at his home in Clarksburg, W. Va., following a short illness.

Mr. McNicol was born in East Liverpool, Ohio, January 4, 1890, a son of the late Mr. and Mrs. D. E. McNicol. He was graduated from the East Liverpool high school in 1908 and studied business administration at Duquesne University in Pittsburgh. He was associated with the D. E. McNicol Pottery Co., founded by his father, until 1916, when he moved to Clarksburg to take a position with the McNicol Pottery, which had been built in 1914. He was vice-president, secretary, and sales manager for the Clarksburg pottery at the time of his death.



D. E. McNicol, Jr.

Mr. McNicol entered the military service in September, 1917, and went to France with the 15th Field Artillery of the Second Division in March, 1918. He was wounded in Belleau Wood in June, 1918, while furnishing the artillery support for the Marine Corps offensive against the German advance. He was returned to the United States in October as a casualty and remained in the Walter Reed Hospital until January, 1919, when he was discharged. He returned to Clarksburg to resume his connection with the McNicol Pottery.

He is survived by his widow and a daughter.

Mr. McNicol had been a member of the American Ceramic Society for a number of years.

W. S. COOK

Word has been received of the death of W. S. Cook on September 10, 1937. Mr. Cook was associated with the Victor Insulators, Inc., Victor, N. Y., and was well known among the utilities and insulator groups. He began his activities in 1912 as a designer and plant manager for the Canadian Porcelain Co., Hamilton, Ontario. About 1915, he accepted a position as inspector for Stone & Webster Engineering Corp., of Boston, Mass., and in 1922, he became insulator expert for the General Porcelain Co., Parkersburg, W. Va.

About 1924, he established the Cook Porcelain Insulator Co. of Cambridge, Ohio, of which he was general manager until April, 1936. Four months later he became plant manager of Victor Insulators, Inc.

JAMES M. BEATTY

James M. Beatty, president of the Federal Glass Co., Columbus, Ohio, died of bronchial pneumonia in November, 1937.

Mr. Beatty was born in Steubenville, Ohio, on November 2, 1876, the son of Sarah (Means) and Robert J. Beatty. He spent his boyhood days there and prepared for college at Trinity Hall Academy, Washington, Pa. Following his preparatory work, he enrolled in Sheffield Scientific School, Yale University, and was a member of the class of 1896.

The Beatty family has been identified with the glass industry for nearly a century, the first factory having been established in Steubenville in 1846 by his grandfather, A. J. Beatty. Following the establishment of the first plant, others were erected in Tiffin, Ohio, Washington, Pa., and Dunkirk, Ind., by other members of the family.

Mr. Beatty's father, A. J. Beatty, and an uncle, G. B. Beatty, established the Federal Glass Company in 1900. Mr. Beatty was associated with them, and upon the death of his uncle in December, 1916, assumed the presidency of the firm, which he held until his death.

In his capacity as president of the Federal Glass Co., Mr. Beatty was a leader in the development of automatic machinery for the manufacture of glassware and was responsible for a great deal of the industry's progress in that field.

Mr. Beatty is survived by his wife and one son, Robert J. Beatty.

STUDENT HOTEL RATES IN NEW ORLEANS

Rates for the students who will attend the Fortieth Annual Meeting of the Society are quoted by the hotels as follows:

MONTELEONE: $1.50 per person, room with bath, $1.00 without bath.

ST. CHARLES: $1.50 per person, room with bath.

DE SOTO: $1.00 per person, room without bath.

JUNG: $1.50 per person, room with bath.

LA SALLE: $1.00 per person, room without bath; $8.00 two connecting rooms with bath between, accommodating 7 persons.

ROOSEVELT: Five in a room (with bath) $2.00 per person; four in a room (with bath) $2.50 per person.

Above rates (with the exception of the Roosevelt and La Salle) are based on six to eight persons to a room.

—SAM FOWLKES, *Secretary, Convention and Visitors' Bureau*

Plan to Attend the Annual Meeting
New Orleans, La.
March 27–April 2, 1937

RULES FOR PRESENTATION AND PREPARATION OF PAPERS AT TECHNICAL SESSIONS OF THE AMERICAN CERAMIC SOCIETY*

I. General Information

(1) Listing of Papers

The papers on the Division Programs will be called in the listed order. Except at the discretion of the presiding officer, the order will not be altered. Papers called without response will automatically go to the end of the list where they may be called if time permits. Titles submitted too late to appear on the program will be announced at the opening of the meeting and will be given a place at the end of the regular program.

Papers listed by authors who are not present at the meeting will not be read unless those present express by vote their wish to hear them.

Written discussions are desired and invited; if made known, they may be given before extemporaneous oral discussions.

(2) Presentation of Papers

Careful preparation of papers and attention to the manner of presentation are as necessary to the speaker facing a technical audience as they are to the lawyer pleading at court.

Authors, except specially invited lecturers, are expected to present their papers in 15 minutes. Where the text is long or the mass of data is too great to permit this, the paper should be abstracted and only the salient points presented in order to keep within this limit. The chairman may extend the time of a speaker on vote of those present.

A careful selection and summarization should be made of the most important parts of each paper. This should include not more than one thousand words and should be less for slow speakers. While undue haste will lessen the effectiveness of the speaker, lengthy pauses, owing to unfamiliarity with the speech, are a waste of time and are extremely trying to the listeners.

There are four ways to deliver an address:

(*1*) *Reading from Manuscript:* Reading with the eyes almost constantly on the manuscript is emphatically condemned. This method will not hold the attention of the audience.

(*2*) *Speaking from Notes:* Speaking from notes is less disturbing to the listeners than reading from the completed manuscript.

(*3*) *Speaking Memoritor:* A thoroughly well-memorized speech can be successful if learned so well that the speaker is not haunted by fear of forgetting so that when speaking he can realize the full significance of what he is saying.

(*4*) *Speaking Extempore:* This is the most effective method of delivering a speech. It demands most thorough preparation. The speaker should write and rewrite the address several times and then read it aloud at least twenty times, each time trying to convey the meaning to an imaginary audience. Afterward, he should speak it aloud without the manuscript many times, making no attempt to memorize it verbatim, but leaving the choice of words to the occasion. If inexperienced, it is always an aid to confidence to memorize the introduction and conclusion.

Speakers are urged to use medium-sized filing cards that can be held in one hand leaving the other free for motion. Cards should not be written on both sides, and one idea only should be written on each card.

When the Chairman has introduced the speaker to the meeting, some person in the last row of the audience should be selected and addressed, slowly, distinctly, and loud enough so that he can hear at all times. When showing slides, this person should be addressed. Do not talk to the screen.

(3) Lantern Slides

The slides should be of the standard size used in the United States, *i.e.*, $3^1/_4$ by 4 inches. The lettering should be of such size as to be easily read at a distance from the screen.

(4) Preprinting of Papers and Committee Reports

The Committee on Publications will have the available papers and committee reports to be presented at Annual Meetings in printed form at the Meeting. To render this practicable, the manuscripts should be sent to the Editor at least two months in advance of the Meeting at which they are to be presented. It is manifest, however, that if all papers forming part of a comprehensive program should be received only two months in advance of the Meeting, it would not be possible to have them all in type in a single month. Authors and chairmen of committees are accordingly requested to furnish their manuscripts as far in advance of the Meeting as possible.

In general, the sequence in which the papers are received will determine the sequence in which they will be preprinted.

(5) Discussions

All written discussions shall be placed in the hands of the Division Chairman prior to the session at which they are to be presented. Such written discussions shall take precedence over oral discussions. In the presentation of written or oral discussions, the speaker, in general, will be limited to 5 minutes, but this time may be extended at the discretion of the chair or by vote of the meeting.

(6) Publication in the Technical Press

No paper, committee report, or written discussion shall be released for publication in the daily or technical press in advance of its presentation, except by authority of the Committee on Publications, or after its presentation unless it has previously been edited by the Committee or the Committee agrees to release it without editing.

II. Division Editorial Committee Procedure

(1) Committee Personnel

Each Committee shall consist of three members chosen by their Division officers and members. One of the three persons named shall be appointed chairman of the Committee.

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* Adopted by the Committee on Publications, American Ceramic Society, 1932.

(2) Procedure

(*a*) *Editor's Work:* The paper usually is first edited by the Editor of the *Journal* in such manner as he should judge best suited for publication purposes. If the paper is cut and written over to a great extent, the author's original copy should also be submitted with the revised copy to the Committee. This enables the Committee to judge the value of the Editor's suggestions and to restore portions if they are agreed on such action.

(*b*) *Committee Procedure:* (1) The paper is forwarded to the Chairman of the Division Committee under whose supervision the paper falls. After checking the paper, the Chairman forwards the paper to the second member of the Committee together with his comments.

(2) The second member of the Committee, after reviewing the paper, makes his suggestions and forwards the material to the third member of the Committee.

(3) The third member of the Committee reviews the paper and returns the material with his comments to the Chairman.

(4) The Chairman makes a summary of the accumulated suggestions and returns the paper to the Editor.

(5) Where the Committee disagrees with statements of the author but considers the fundamental work worthy of publication, the paper, with these comments, is returned by the Editor to the author, with the recommendation that he clear up the points in question.

(6) Where the paper does not seem to fit in with the standard quality for the *Journal* or for the *Bulletin*, it is returned to the author so that he may submit it elsewhere for publication. In case of disagreement, the paper becomes the property of the author.

III. Important Constitutional Provision

Article X. Publications

The rejection of papers will be determined chiefly on the following grounds:

(1) The subject matter does not fall within the field of the Society's activities.
(2) The paper contains matter readily found elsewhere.
(3) The contents are of an advertising character.
(4) The author controverts well-established facts.
(5) The subject matter is not new.
(6) The subject matter is essentially of a speculative nature.
(7) The treatment is seriously defective as to literary form and structure, continuity of thought, clarity of expression, etc.

NOTE: The Publications Committee has adopted a rule for its own procedure that (1) no paper or report will be published by the Society that will appear elsewhere in English, except as a reprint from the publications of the Society; and (2) officers of Divisions may, at their own discretion, accept for Meeting programs papers and reports subject to reservation of publication rights by the author.

The Committee on Publications shall determine which papers shall be printed. The Committee may return a paper to the writer for change or correction and may call to its aid one or more members of special experience relating to the subject treated, either to advise on the paper or to discuss it.

Important Notice

All papers, discussions, and other writings which have been presented before the Society, its Divisions, or Sections, and all committee reports shall become the property of the Society. Their publication or other disposition shall be in the hands of the Committee on Publications.

IV. Suggestions to Authors for Preparation of Papers

(1) General

(*1*) *Form:* Papers should be submitted typewritten in *double or triple space* to permit mechanical editing for the printer. White paper, $8^1/_2$ by 11 inches, should be used and the *original copy* should be sent to the Editor. (Do not submit *carbon copies.*)

(*2*) *Abstract:* An abstract statement of the procedure and conclusions of the problem of the paper should be submitted with the manuscript. The length of this abstract will depend on the subject matter of the paper. All of the important results should be included in the abstract. Ordinarily one hundred words are sufficient for this statement.

(2) Footnote References

All footnote references should be in *double or triple space* to permit editing for the printer.

The first reference is an asterisk (*) stating where the paper was presented and the date of its receipt in the Society offices.

Other footnote references are numbered consecutively from 1 up. The following order should be used: author initials and name, title of book or paper, journal name, volume number, issue number, page number, and year. Book titles are *never* put in quotation marks. Articles from publications are *always* put in quotation marks.

EXAMPLE: (1) Hewitt Wilson, Ceramics, Clay Technology, pp. 232–34. McGraw-Hill Book Co., Inc., New York, 1927.
(2) F. A. Kirkpatrick and W. E. Williams, "A Cone Nine Vitrified Floor Tile Body," *Jour. Amer. Ceram. Soc.*, **15** [1] 28–33 (1932).

For abbreviations of periodicals, the style is the same as that in *Ceramic Abstracts.*

References to patents should include patentee, assignee, name of patent (or title), patent number, and issue date.

EXAMPLE: A. N. Cramer (Owens-Illinois Glass Co.), Glassware Annealing Leer, U. S. Patent 1,854,452, April 19, 1932.

NOTE: Responsibility for the accuracy of references rests entirely with the author, although the editorial office spends a great deal of time in verifying such material. A reference has *no value* if it is incorrect.

For bibliographies, the same style is used as given for footnote references.

(3) Tabular Material

All tables are set up without rules. It is important that this material be *double-spaced* in a manner similar to the body of the paper. Tables are numbered with Roman numerals from I.

Abbreviations are permitted in tabular headings, but (″) for inch, (′) for foot, and similar signs should not be

used. It is permissible, however, to use a slant line (/) for per.

(4) Photographs and Line Drawings

All illustrations accompanying a paper should have consecutive Arabic numbers from 1 up, *e.g.*, Fig. 1, Fig. 2, etc. Separate Roman plate numbers are confusing. The figures (photographs and line drawings) should follow consecutively and will be placed as close as possible to their reference in the text. All references to these figures should be made in the same terms as expressed on the figure, *i.e.*, Curves 1, 2, and 3 or *A*, *B*, and *C* should have similar reference in the text of the paper. Where a complete description of the cut is given in the paper, care should be taken not to duplicate this material in the legend of the figure. Authors should indicate the position of figures by marginal notations.

Whenever possible, line drawings should be supplied ready for the engraver. They should be submitted on tracing cloth or plain white paper, drawn to a scale large enough to permit a three-fourths reduction on a drawing of $8^1/_2$- by 11-inch size. Lettering on such a drawing should be $^3/_{16}$ inch and numbers should be at least $^1/_8$ inch.

X-ray and photomicrographs are not reduced in size, but wherever possible are trimmed to leave only the essentials for reproduction.

Blueprints and photostats can not be used for reproduction.

(5) Headings on Papers

The title of the paper is always all capital letters with no punctuation. Headings should not be underscored.

Following the abstract of the paper, the usual procedure is (1) introductory material, stating the problem and reasons for the report, (2) historical survey of previous work, (3) plan of procedure and apparatus, (4) test methods, (5) test results, (6) discussion of results, and (7) general conclusions. Of course, the main center headings to be used depend on the type of material being reported.

This outline is only general, but these titles, if used, are centered and numbered in Roman numerals. (Occasionally it may be necessary to insert a centered subtitle.) Side headings are numbered in Arabic numbers in parentheses, and if subside headings are required, lower case letters in parentheses are used.

EXAMPLE:
I. Introduction
II. Present Work
(A) Mo Spiral Winding and MgO Refractory.
(B) Zigzag Winding and MgO Refractory
(center sub-heading—not often used)
(1) Zigzag Welded Winding (side flush heading)
(*a*) Sub-side heading
(italic and run in with text)

V. Miscellaneous Rules

(1) Do not use professional titles and Mr. with names (except where there are no initials given).

(2) Use dieresis with oö and eë (not hyphen). *Example:* coöperation.

(3) Pounds, feet, inches should be spelled out in the text, except where a long series of weights or dimensions occurs.

(4) Abbreviations used in the text are as follows:

3 lb. (not lbs. or #)	18% (not 18 per cent)
7 ft. 6 in. (not 7′ 6″)	92°F (not degrees or Fahr.)
9 by 12 ft. (not 9 x 12)	No. 2 (not #2)

(5) Use "x" for "by" in expressing dimensions in tabular material.

(6) Omit comma in figures up to 10,000 (1492, not 1,492).

(7) In decimal numbers having no units place a cipher before the decimal point (0.641 not .641).

(8) If Greek letters or mathematical symbols are used, indicate identification in the margin.

In formula material, where the printer may confuse the typewritten letter "l" and the numeral "1," indicate their correct use. This also applies to the capital O and the numeral zero.

(9) Spell out numerals at the beginning of a sentence.

(10) Where one number follows another without punctuation, spell out one of them, preferably the first (sixteen 4-in. sheets).

(11) Spell out numbers from 1 to 10 unless used in series.

FORTIETH ANNUAL MEETING, NEW ORLEANS, MARCH 27-APRIL 2, 1938

WHAT F. R. PORTER CAN GAIN

From my experience in attending any Meeting of the American Ceramic Society, I personally anticipate a gain on at least four counts from the coming Meeting.

New Ideas Presented in Papers

Something of value to my problems has always been obtained from a share of the papers presented at these Meetings, something new in the way of better processing, superior raw material, or superior equipment. It is true these papers are later published, thus making the ideas available to those not fortunate enough to be present, but by attending the Meeting I get these ideas first-hand and much sooner than if I waited for their publication. In some cases, new ideas so gleaned have been put into immediate use with enough increase in efficiency of operation to more than offset my total expenditure for the Meeting.

New Ideas from Association

There are the "off-the-record chats," stimulated or provoked by the papers and discussions of the regular sessions. These discussions tend to be much more lively and candid

than is developed in some of the meetings and provide a never-failing source of valuable information and ideas. This I feel is a very important part of the Annual Meeting.

Old Friends and New

Perhaps no monetary value can be placed on the social aspects of the Meeting, but I do enjoy the renewal of acquaintances and the forming of new contacts. I believe it does something to round out the life, perhaps, of all of us. It is difficult to put it in words but much good is there, I know.

Loyalty

Last but not least, I like to show by my presence that I am behind the organization in its effort to further the industry or profession in which I earn a living. The officers of the Society spend a lot of energy and money in developing the Meeting programs. They are doubling their efforts this year and there are indications that an unusually fine program will result. In addition, New Orleans is a city of unusual interest and think how good a few days "in the Southland" are going to feel to us shivering Northerners along about the last of March! I'm for it!

—FRANK R. PORTER

RAIL FARES OF LOUISVILLE AND NASHVILLE RAILROAD COMPANY

The fares quoted by J. H. Gentry, Traveling Passenger Agent, are effective as of November 15, 1937, and have been established by the Interstate Commerce Commission.

All rates quoted are first class, and the rate from Los Angeles to New Orleans is the same as the rate quoted from San Francisco, *i.e.*, 30-day limit, $90.30, which is good in tourist sleeping cars, or 30-day limit, $105.80, good in standard sleeping cars.

The Pullman rates from Cincinnati to New Orleans are as follows: lower, $6.00; upper, $4.80; drawing-room, $21.00; and compartment, $17.00.

ROUND-TRIP FARE

From	(18 days)	From	(18 days)
Portland, Me.	$83.05	Chicago, Ill.	$42.25
Boston, Mass.	76.95	Indianapolis, Ind.	41.95
New York, N. Y.	64.85	St. Paul, Minn.	57.70
Albany, N. Y.	64.85	Minneapolis, Minn.	58.05
Corning, N. Y.	64.35	Milwaukee, Wis.	46.10
Buffalo, N. Y.	64.35	Seattle, Wash.	110.00
Philadelphia, Pa.	59.45	Spokane, Wash.	100.35
Pittsburgh, Pa.	53.75	Portland, Ore.	110.00
Cleveland, Ohio	53.95	San Francisco, Cal.	90.30
Columbus, Ohio	45.65	Los Angeles, Calif.	90.30
Toledo, Ohio	50.55	Denver, Colo.	75.20
Springfield, Ohio	43.45	Dayton, Ohio	41.95
Detroit, Mich.	53.95	Cincinnati, Ohio	37.95

Time Schedule

The following schedule is given for the trip from Cincinnati to New Orleans and for the return trip:

Lv. Cincinnati	10:00 A.M.	7:15 P.M.	(ET)
Ar. New Orleans	7:55 A.M.	7:40 P.M.	(CT)
Lv. New Orleans	8:45 A.M.	8:20 P.M.	(CT)
Ar. Cincinnati	11:55 A.M.	9:20 P.M.	(ET)

MRS. DIXON VOLUNTEERS NEW ORLEANS TESTIMONY

I can not tell you how anxious I am to attend the New Orleans Meeting, where there will be so much to learn and so many interesting persons from whom to learn.

And then New Orleans itself! And all the friends of a fascinating winter of 1911–1912, when the Dixon family cruised there on "The Lad," our houseboat with her own power, and lived on the Bayou St. John with every day a wonder story; then we cruised back again through adventurous high water. (To date, "The Lad" is, in fact, the only gasoline craft that has made this trip from St. Paul to the Gulf and return under her own power.)

—ANNA LANE DIXON

NEW ORLEANS ENTIRELY UNFAVORABLE—BUT WHY?

My reaction to New Orleans as a Meeting place is, up to date, entirely unfavorable. Nonetheless, I hope the Meeting will be a success, though I shall probably not be there. Why not try Rio or Fairbanks, Alaska?

—F. W. PRESTON

GREYHOUND BUS FARES TO NEW ORLEANS

	One Way	Round Trip
Houston, Tex.	$6.50	$11.70
Dallas, Tex.	7.75	13.95
Ft. Worth, Tex.	8.30	14.95
San Antonio, Tex.	9.50	17.10
El Paso, Tex.	19.45	35.05
Los Angeles, Calif.	27.50	49.50
San Francisco, Calif.	27.50	49.50
Seattle, Wash.	36.00	64.80
Denver, Colo.	20.25	36.45
Kansas City, Mo.	13.20	23.85
St. Louis, Mo.	9.50	17.10
Chicago, Ill.	12.30	22.15
Memphis, Tenn.	6.50	11.70
Cincinnati, Ohio	10.75	19.35
Detroit, Mich.	14.20	25.60
Chattanooga, Tenn.	6.75	12.15
Pittsburgh, Pa.	14.50	26.10
Atlanta, Ga.	6.65	12.00
Washington, D. C.	13.85	24.95
New York, N. Y.	16.55	29.80
Savannah, Ga.	8.80	15.85
Jacksonville, Fla.	8.20	14.80
Tampa, Fla.	10.65	19.20
Miami, Fla.	12.95	23.35

Membership in
American Ceramic Society

FOR CONTINUING EDUCATION IN CERAMICS

OFF TO LOUISIANA IN MARCH, 1938

PAUL F. KERR, ORTON MEMORIAL FELLOW LECTURER

"A Decade of Research on the Nature of Clay," is to be the subject of the lecture to be given by Paul F. Kerr, Orton Memorial Fellow lecturer, at the Fortieth Annual Meeting at New Orleans, La.

Dr. Kerr says of his lecture, "It is my purpose, in selecting this subject, to present a generalized summary of recent advances in the study of the origin and crystallization of the clay minerals. It would also be my purpose to touch briefly upon the nature of the work that is being carried on both in this country and abroad at the present time, indicating the purpose of the studies and the results that have been secured. Naturally, I will be interested in the kaolin minerals. Since, however, clay mineral research has been actively progressing along other lines, particularly in the field of study of absorptive clays, it would seem to me that that phase of the subject should not be neglected.

"It is my hope that methods of illustration and devices for concentrating the discussion on fundamentals may suffice to lighten the presentation in such a way that the lecture may be understandable and of interest to a mixed audience and at the same time retain the scientific dignity which such a presentation should have."

THE ISAAC DELGADO MUSEUM OF ART [1]

Ellsworth Woodward, president of the Isaac Delgado Museum of Art, has extended a cordial invitation to members of the American Ceramic Society attending the New Orleans Meeting to visit the Museum.

"The Board of Trustees of the Delgado Museum of Art, at its regular monthly meeting yesterday, cordially gave consent to your request that the Museum building be opened to the visiting delegates of the American Ceramic Society on March 30 or 31 from 8:00 to 10:00 P.M.

"We shall be pleased to have this body of distinguished specialists, coming as it will from every state in the Union. While we have comparatively little to show to those familiar with the great museums of the North and West, we hope they will be interested in the foundation of collections, destined, we believe, to become important in the future.

"As an outline of what may be seen the following is given:

Ceramics

Sèvres porcelain: Imperial, Royal, and Napoleonic; a number of monumental examples of superior excellence.

A quaint exhibit of bazaar show-pieces, much prized in the early 19th Century.

A number of valuable Chinese and Japanese examples and a miscellaneous collection representing most of the ceramic productions.

A representative assembly of Newcomb pottery, showing its early groping after what later became an important contribution to American fictile art. We regard this collection as important in a peculiar sense, because it represents the first serious movement in the South to associate art with manufacture, pointing toward a remunerative artistic occupation for young designers and insisting at the same time upon the local origin of design forms. This collection may be considered unique.

There are also a few examples of ancient Greek pottery, dating from about B.C. 500, given by Alvin Howard.

Bronzes

The Cline collection of ancient Oriental bronze utensils, Buddhas, and ceremonial objects.

A representative showing of bronze figures of an academic type, giving an understanding through their uniform character of the taste of society as to *objets d'art* in the last Century.

Jade and Glass

The Morgan Collection of jade and quartz is of the highest quality.

The Howard Collection of antique glass, though small, is very important.

Painting

The Hyams Collection of late 19th Century academic French canvases is as complete and important as any in the country. This gallery alone is enough to warrant the attention of the student and the admiration of the laity.

Contemporaneous paintings are shown in two galleries. Among these are good examples of many artists.

Library

Visitors familiar with the problems of library formation will be interested by the small but fundamentally important assembly of contemporaneous material upon which must rest future histories of individual artists and art movements. Art in the South in the past has lacked both creative impulse and sympathetic historians. The southern section of today is showing a vigorous art revival. Knowledge of this present movement must be sought in catalogues, newspapers, and critical journals. Our library, through the coöperation of the federal WPA, is engaged in collecting and indexing information as to present activity and submerged items regarding artists of the past who have suffered neglect.

"Our Board of Administrators welcomes the proposed visit of so large and cultivated a representation of craftsmen, the tastes and interests of whom bear so directly upon the industrial art of America."

—ELLSWORTH WOODWARD

[1] Letter dated November 19, 1937, to Mrs. George C. Westfeldt, 3120 Coliseum St., New Orleans, La.

BOB GOULD'S INVITATION

We shall be very pleased to have you announce in your *Bulletin* that members of the Ceramic Society will be cordially invited to stop off at Norris to visit the ceramic laboratory on their return home from the Meeting in New Orleans the week of March 27. Persons wishing to make this stop should communicate with me so that transportation from Knoxville may be properly arranged.

R. E. GOULD, *Chief Ceramic Engineer,*
Tennessee Valley Authority

THE CABILDO

Barnum, the great showman, would have said with an introductory barrage of verbal superlatives, "Step right up, ladies and gentlemen, and see the greatest show on earth for twenty-five cents."

New Orleans, like Barnum, shouts an invitation to see a million-dollar show of artistry, beauty, historic value, and general interest that is held daily in the Cabildo, situated in the midst of surroundings and buildings rich in romantic lore in the heart of the French Quarter. The essential difference between New Orleans and Barnum is that, in New Orleans, the show never stops and there is no admittance price.

Varied have been the experiences of this massive and ancient building. Records tell of its construction by Don Almonaster y Roxas, and it once served as a residence for the distinquished Marquis de Lafayette of France during his visit to New Orleans. Changing from a sumptuous residence it became, among other things, a church, city hall, courthouse, and a jail.

Of greater significance is the fact that the largest real estate transaction in America was in the Cabildo, in the purchase of the Louisiana Territory by the young American republic from the Emperor Napoleon of France. Foresightedness of the infant American nation and its realization that the future welfare of the country depended upon the control of the strategic port of New Orleans started the wheels that culminated in the acquisition of the vast inland empire from France. Since the world began, politics have played an important part in life, and the Cabildo has witnessed many phases of these struggles in America. The term, "Cabildo," from which the structure derives its name, is from the form of Spanish colonial government used during a period in the early life of New Orleans. In appearance, the building has changed its exterior characteristics when the present French mansard roof was built, but in the interior the impressionable and beautiful Spanish walls have been carefully preserved.

In the Cabildo, which has been the scene of many foremost State and city events, are housed fascinating exhibits, including Indian arrowheads and other small articles which might be duplicated in many family attics, priceless historical papers, articles, and oil paintings telling of the early settlement in the Mississippi Valley.

Beginning with a comparatively small collection of objects, the exhibit has grown to such large proportions that it now includes displays of Louisiana's archeology, history, education, mineral resources, agricultural and commercial mementoes, and natural history.

A trip through the Cabildo and up the succession of wooden and stone steps at the front entrance is equivalent to a journey through Louisiana history. There are portraits of King Louis XIV of France, Phillip II, Duke of Orleans, after whom the city was named, and the explorers and colonizers, La Salle, Iberville, and Bienville. The Sala Capitular, on the second floor of the St. Peter Street side, features the relics of the Louisiana purchase and transfer. In the war museum, the visitor, with a little imagination, will find himself at the Battle of New Orleans; there is a gallery of portraits and photographic enlargements of the famous battle. From all corners of the world, portraits have been collected to complete this pictorial history.

On the second floor are exhibits of the Mexican War and the shrine to General Zachary Taylor, the exhibits of the War between the States, the shrine to General P. G. T. Beauregard, and souvenirs of the hectic reconstruction era.

The first floor is devoted to World War mementoes. The Spanish American War souvenirs are in an upper room on the Orleans Alley side of the Cabildo.

The museum of war is in the State armory and overlooks a small patio paved with street blocks, said to have been culled from the beds of Portuguese rivers and brought over to America as ballast for ships. On the other side of the patio are two sentry rooms that have recently been remodeled to preserve the tradition that the pirate, Jean Lafitte, at one time either pursued the craft of a blacksmith or maintained, with his brothers, a blacksmith shop as a "front" for illicit operations. A brick blacksmith shop forge, typical of those used in the latter part of the 19th Century, has also been built in which there is an imitation fire blown by a bellows, operated by a massive lever of timbers, and a collection of blacksmith instruments.

Above the sentry rooms is the Spanish American Hall of Honor, and adjoining the war museum is a rebuilt structure, still called, for want of a better name, the "Jackson House." Opposite the Jackson House is a contemporary building known as the "Creole House" that, according to a recent plan, will be equipped with genuine furnishings of the Creole period.

Linking the top floor of these two buildings is a Creole roof-garden, typical of many which mark the Vieux Carré architecture. In the courtyard are to be found fixtures of the period, including a central water fountain, flower beds, a 19th Century French lamp post, and massive jars of the type once used to hold water.

In the section of the Cabildo fronting Chartres Street are colonial relics, a collection of marble statuary, a cabinet of Italian majolica vases, and the death-mask of Napoleon. This death-mask, estimated to be worth more than $20,000, is bolted to the floor, and the case in which it lies is charged with electrical current to prevent possible theft.

Along the stairway leading to the third floor is a series of fifty-eight portraits which merge into a gallery of paintings grouped according to authorship. There are also exhibits of period costumes, clothes worn in former Mardi Gras celebrations, dolls, fans, and a particularly interesting group of portraits, the women subjects of which all wear bonnets.

The exhibits are not confined to the finer arts. Various collections trace the *ten flags* under which Louisiana has been governed.

COMMUNICATIONS—CERAMIC HISTORY

JAMES TAMS, DEAN AMONG POTTERS

Trenton Manufacturer Has Watched the Trade's Development from the Old Redware Days

EDITOR'S NOTE: James Tams died in 1911, one year after this story was written. The story was published in the *Pottery, Glass, & Brass Salesman*, March 2, 1910. Notes for this story have been supplied by Harry J. Podmore.

Trenton's fame as a pottery center has often furnished a theme for writers in the trade journals, and the history of the industry, or art, if you will, in that city has been told and retold. In view of this, it seems rather strange that the life story of James Tams, than whom no manufacturing potter has done more to add to the commercial laurels of the New Jersey capital, should never have been authoritatively related. He is probably the oldest potter in the United States today in point of continuous activity in the trade. The plant he has seen grow from a comparatively insignificant institution to a great twenty-six kiln pottery could unfold a tale which might easily be woven into a work of fiction.

Away back in the early sixties, a young man drove in a light wagon through one of Trenton's principal streets, out over the bridge spanning the Delaware River and into the uplands of Pennsylvania where he gathered a load of flint stones by the roadside. That youth was James Tams, and he took this primitively collected raw material to the Greenwood pottery where he personally ground it to a pulverized state for use in the body of Greenwood ware.

A potter of the old school is he who is capable not only of directing affairs from his office, but who can take the place of any of his host of employees at a minute's notice should such a contingency arise. He knows the art of preparing the raw materials, be they the body components or the pigments that tint the colors in the decorating shop.

Mr. Tams is now in the evening of life, and he does not take active part in the work of the pottery as he did in former years. His son, William Tams, vice-president of the Company, directs that. The senior Mr. Tams is at Palm Beach, Fla., where he is spending the winter. Much of his time of late he has devoted to travel and well-earned recreation

His Father, William Tams

He was born in Staffordshire, England, in 1845, and came to this country with his father, William Tams, in 1861. The father took possession of an old carriage shop on the site of the present main plant of the Greenwood Pottery Co., and it was here, in a modest way, that the first ware was turned out. With the elder Mr. Tams, there was associated in the enterprise, William Bannard. William Tams was a dipper and kiln firer by trade, having learned the work in England. Immediately after coming here and before starting in business for himself, he worked in Young's Pottery which was conducted on the site of the Willetts' Pottery, the present plant of the New Jersey China-Pottery Co. James Tams was also a kilnman at Young's.

James Tams Buys into Greenwood

After spending some time in the Greenwood plant where he was dipper, kiln placer, and kiln firer, in the making of C. C., W. G., and P. G. ware, the latter being the semi-porcelain ware of today, James Tams went to England in 1864. He married there, and the following year he returned to Trenton. In the meantime his father had associated with him J. P. Stevens and Charles Brearley. It was for this firm that James Tams went to work in 1865. At the death of his father, the following year, James Tams bought his stock and the Greenwood Pottery was conducted by Brearley, Stevens, and Tams.

Made Vitrified China

Up to this point, the progress of the Greenwood had been more or less ordinary but, with the advent of James Tams, a new life was infused which was destined ultimately to win fame for the Company and to build it up to be this country's leading factory of its kind in that period. William Tams had found it unprofitable to make bone china because there was little or no protective tariff, but James Tams, the son, staked his all on the production of a ware that would lift this country to a materially higher plane in the pottery world. His desire to accomplish this was made all the more keen by a visit to the Centennial Exposition in Philadelphia, where he viewed with mingled feelings the superior displays of foreign manufacture as compared with domestic ware of that day.

As soon as practicable, the manufacturing of the C. C., P. G., and white granite was discontinued at the Greenwood, and in its stead came forth the first of this country's vitrified ware.

Jobbers refused to handle it and Mr. Tams met discouragement on every side. He went personally to the hotels with his samples, and finally induced the proprietors to take some of the ware on trial. The rest was easy and ere long the jobbers were glad to take it on. The original plant of the Greenwood company was soon found to be inadequate with its two kilns to supply the demand. Other kilns were built, and the old Eagle Pottery and the former Burroughs & Mountford Pottery were added to the capacity. In the early days of the Greenwood one heard very little of the western potteries—which have since made such great strides.

The Greenwood enjoys the distinction not only of having been the first domestic pottery to put vitrified ware upon the market, thereby greatly raising the American standard at that time, but it also was the first to make fancy goods, vases, and similar other articles in pottery not of a strictly utilitarian nature. The fancy goods were an important

feature of the business and one of the most profitable until the demand for hotel ware in a rapidly developing country became so great that the manufacture of the other lines had to be dropped in order to supply the hotel trade.

As the Greenwood took precedence in fancy goods so did it also in Belleek, electrical porcelain, and bone china.

James Tams has seen the pottery industry of this country gradually develop from the old redware period to the splendid products the factories are turning out today.

He is never happier than when walking about his shops and noting the progress of the work. He is a born potter and, from his earliest days as a workman, has taken a keen interest in everything pertaining to the art. At the age of sixteen years, he compounded a formula for bodies which he gave to his father and the latter employed it with great success.

So thoroughly imbued was he with the pottery idea that he frequently burned the midnight oil in working out problems in ceramic chemistry or other branches of the business.

His career seems a literal example of the poem:

"The heights by great men reached and kept,
Were not attained by sudden flight.
But they, while their companions slept,
Were toiling upward in the night."

Mr. Tams has six sons who are now actively engaged in the work he laid out. William H. Tams, his eldest son, is vice-president of the Company and its general manager.

James Tams as a Business Man

While the senior Mr. Tams has been successful as a potter to an unusual degree, it was not altogether in this line that he was enabled to amass a competence. Indeed, much of the money he accumulated in making ware went back into the business which was and is with him so strong a hobby. He has dealt extensively in real estate and not a few of his friends were wont to advise him that the road to wealth, if not artistic success, in his case, was as a trader of lands.

Many thousands of dollars have been invested in clay deposits in this country largely upon the advice of Mr. Tams to whom samples of the clay had been submitted for inspection. On the other hand, enthusiastic prospectors have been restrained by the advice of Mr. Tams from spending money in clayworkings in which he had no faith. He has been the friend and adviser of many a rival manufacturer of pottery who went to him sorely distressed over some problem which would have to be solved or work ruin for them. There are no clay beds of importance in this country with which he is not familiar as far as the quality of the products is concerned.

Reference Material on Life of Tams

Reference is made to the following books: (1) E. M. Woodward and John F. Hageman, History of Burlington and Mercer Counties, p. 693. Published by Everts & Peck, Philadelphia, Pa., 1883. (2) Edwin Atlee Barber, Marks of American Potters, p. 46. Published by Patterson & White Co., Philadelphia, Pa., 1904. (3) Edwin Atlee Barber, The Pottery and Porcelain of the United States. (4) William F. Crosley, The Trenton City Directory for 1869. Printed by Murphy & Bechtel, Trenton, N. J., 1869. (5) Frances B. Lee, Mercer County Families.

PERKIN MEDAL TO DR. TONE

The Perkin Medal for 1938 was presented to Frank J. Tone, president of the Carborundum Company, at a joint meeting of the American Section of the Society of Chemical Industry and the American Chemical Society, held at The Chemists' Club, New York City. James G. Vail, chairman, presided over the meeting. Carl G. Schluederberg gave a talk on the life and accomplishments of the medalist, and, the Medal was presented to Dr. Tone by Marston T. Bogert. After the presentation, Dr. Tone gave his Medal address entitled "The Quest for Hard Materials."

The development of abrasive materials began with the prehistoric craftsman who shaped crude implements by rubbing them on stone and has continued in steps involving better abrasives and mechanisms for their use, up to silicon carbide and fused alumina which now dominate the industry. Acheson's discovery of silicon carbide probably went further in one step than mankind had gone in all previous history.

New research tools now for the first time reveal the true nature of many new superhard compounds. Sections cut with bonded diamonds show that certain carbide fusions solidify as two separate constituents and are not "double carbides." As a result of the newer methods, much of the chemistry of such substances must be rewritten. New and harder abrasives are in prospect. Molten boron carbide dissolves other carbides which crystallize out upon cooling, thus affording the first opportunity to study many carbides in the form of crystals rather than discontinuous powders. Silicon carbide and boron carbide form a definite eutectic.

To illustrate points of his talk, Dr. Tone showed Laue photograms of silicon carbide which correspond to modifications previously found in the literature. He also showed micrographs of silicon-carbide and boron-carbide fusion as well as other carbide fusions and of new modified alumina abrasives, including chrome-alumina and $3Al_2O_3 \cdot B_2O_3$. The use of the thermal microscope with motion-picture attachments was described for microscopic observation of reactions at temperatures up to 2000°C.

Dr. Tone was born in western New York in 1868 and was graduated from Cornell University in 1891 with the degree of electrical engineer. His connection with the chemical field dates from the inception of Niagara power in 1895, when he became associated with Edward G. Acheson in the development of "Carborundum" as works manager and later as president of the Carborundum Company at Niagara Falls. He became one of the pioneers, not only in the development of electric furnaces on a large scale, but also in the new abrasive art which began with electrothermally produced abrasives. Paralleling his achievements in this field, Dr. Tone was responsible for the application of these same products as refractories, thus initiating the super-refractories industry. He was also the original producer of electrically fused mullite and spinel. Silicon-carbide electric heating elements are also a result of his work. Dr. Tone's outstanding contribution in the electrometallurgical field was the development of a large-scale process for producing silicon metal, now widely used in making alloys of aluminum and steel and as a reducing agent in the manufacture of low carbon ferro alloys.

He was awarded the initial Jacob F. Schoellkopf Medal by the American Chemical Society, the Edward Goodrich Acheson Medal by the Electrochemical Society, and an honorary degree of Doctor of Science by the University of Pittsburgh. He is a member of the American Ceramic Society, the Society of Chemical Industry, the American Chemical Society, the Electrochemical Society (past-president), the American Institute of Mining Engineers, and the American Institute of Chemical Engineers. He is the author of a score or more of technical articles and has had many patents granted to him.

HONORARY DEGREE TO ROBERT LINTON

At the celebration of Founders' Day on October 30, 1937, Washington and Jefferson College, his alma mater, conferred on Robert Linton, consulting engineer of Los Angeles, the honorary degree of Doctor of Science.

Robert Linton

Dr. Linton's engineering activities have been partly in the ceramic field, partly in mining. He completed his education by spending two years in ceramic and metallurgical work at the Charlottenburg Polytechnic, Berlin, Germany.

It was while he was with the American Window Glass Company, at the beginning of the present Century, that the machine for blowing window-glass cylinders was developed, and he is credited with having contributed in an important way to bringing it to commercial success. For several years he was vice-president and general manager of Pacific Clay Products of Los Angeles and, during that period, he served for three years as president of the Clay Products Institute of California. He also represented the Pacific Coast on the board of directors of the American Face Brick Association. He is active on Committees C-4 on Clay Sewer Pipe and C-8 on Refractories of the American Society for Testing Materials and is a Fellow of the American Ceramic Society, having been actively concerned with the work of the Society since 1924.

In the mining field, he was actively engaged in the examination and operation of metal mines for a number of years. He was president of the North Butte Mining Company from 1918 to 1923, vice-president and managing director of Consolidated Copper Mines, and has been directing executive of several other mining companies. He served for five years as chairman of the Committee on Industrial Relations of the American Institute of Mining and Metallurgical Engineers and is at present vice-chairman of the Institute's Industrial Minerals Division. He has served as chairman of the New York Section and the Southern California Section of the Institute and as president of the Los Angeles Section of the American Society of Civil Engineers.

Dr. Linton has contributed numerous articles to the transactions of societies of which he is a member and to technical journals, several of which have been translated and published abroad. His paper on "The Window Glass Machine" was awarded the silver medal of the Engineers Society of Western Pennsylvania.

In conferring the degree, President Ralph Cooper Hutchison said in part:

"After your studies here and in Germany and Belgium you became a pioneer in the glass industry through the introduction of methods of technical control. Turning to mining engineering you again became noted for your work with cyaniding and in the standardization of operations in copper mines. More recently you have made engineering contributions to the clay-products industry which have attracted national attention. Your writings have been distinctive in the technical journals of this country and Europe. Most important for us here, you have demonstrated the power of the liberally educated man in the technical field and, while maintaining a constant engineering achievement, you have enriched your life and thought with the finest culture and with a character of both personal and social values."

NOMINATIONS FOR HONORARY MEMBERSHIP

The Committee on Honorary Membership, consisting of R. G. Cowan, M. E. Holmes, and A. Silverman, *Chairman*, would appreciate suggestions from Fellows and Active Members of the American Ceramic Society regarding eminent individuals here and abroad who should be considered by the Committee. Address communications to Alexander Silverman, Department of Chemistry, University of Pittsburgh, Pittsburgh, Pa.

THE ORTON FOUNDATION FELLOWSHIPS*

Anyone interested in applying for an Orton Fellowship for the coming school year should get in touch with the Foundation direct or he should apply to the particular school which he hopes to attend.

The Fellowships are for graduate study and are available at the following schools: Rutgers University, University of Illinois, Pennsylvania State College, and Ohio State University. The Foundation will be glad to give particulars about the Fellowships. Address The Orton Foundation, 1445 Summit Street, Columbus, Ohio.

If you apply either direct to the Foundation or to the school you should give (1) your school record, (2) why you are interested in doing graduate work, (3) references from your professors, and (4) if possible, suggest a problem that would be of interest to the ceramic industry.

All other things being equal, the man suggesting the most interesting problem will be given the preference when the Fellowships are awarded.

These awards are the highest honor that a young man can attain. The holder of an Orton Fellowship is to be recognized as an outstanding man.

The problem and the man's qualifications will be scrutinized both by the Foundation and the school which the applicant hopes to attend.

Applications must be made before April 15, 1938, so that the applications may be acted upon by the Board.

PENNSYLVANIA STATE COLLEGE EXTENSION TRAINING OFFERED IN THIRTY-FIVE COUNTIES

Mineral Industries Extension Classes in 98 Centers

Four thousand three hundred and forty-seven students are enrolled in various courses offered by the extension division of the School of Mineral Industries at the Pennsylvania State College this year.

The greatest enrollment is found in the classes in mining. One thousand nine hundred and seven persons are enrolled in 93 classes taught in 59 centers located in 18 counties.

Classes in metallurgy closely follow those in mining in size. One thousand three hundred and ninety-one persons are enrolled in the 48 metallurgical classes which are located in 15 centers in 11 counties. Petroleum and natural gas engineering is third in enrollment with 802 students in 34 classes located in 15 centers which are distributed among 10 counties. **Two hundred and forty-seven are enrolled in nine ceramics classes, each of which represents a different center and county.**

One hundred and sixty-eight teachers are employed.

Curricula on Three-Year Basis

The various curricula are prepared on the basis of a three-year program of fundamental instruction designed to correlate theory with practical work. The classes meet for 120 class hours each year and successful students are awarded certificates upon completion of each year of the work and an extension diploma when they have completed the course. The work is of less than college grade and is conducted strictly on an adult vocational educational basis.

This year, because of greater latitude in federal legislation providing money for vocational instruction, the demand upon the college for educational programs in the mineral industries is greater than ever before.

Nine class centers in ceramics have been organized at Clarion, Derry, Kittanning, Lock Haven, Mount Union, New Brighton, New Castle, Summerville, and Washington.

In addition to the director and two stenographers, the personnel of the extension division includes D. C. Jones, supervisor of coal mining extension, E. J. Teichert, supervisor of metallurgy extension, M. M. Stephens, supervisor of petroleum and natural gas extension, E. P. McNamara, supervisor of ceramic extension, and Keith D. Pfoor, assistant supervisor of coal mining extension.

GEORGIA JUNIOR MINERAL INDUSTRIES SCHOOL

The Third Junior Mineral Industries School will be held n the Department of Ceramic Engineering of the Georgia School of Technology in August and September, 1938, according to A. V. Henry, Director.

Encouraged by the outstanding success of the first two projects in which high-school seniors from all over Georgia came to Atlanta on scholarships and there learned at first hand of the scope and methods of various mineral industries, the sponsors expect the third school to excel in enrollment and in the quality of the program. The students again will have one week of intensive study in the classroom and laboratories of the Ceramic Engineering Department. This study will consist of lectures, demonstrations, moving pictures, and actual laboratory practice by the students themselves. Although ceramic industries predominate in this study, other fields such as metallurgy, mining, and geology are also important. Following the week at Georgia Tech, there will be a field trip to mines, mineral deposits, and industrial plants in the southeast.

The Atlanta Rotary Club in former years has sponsored the venture by selecting students, by providing a minimum scholarship fee for several students, and by urging other Rotary Clubs throughout Georgia to do likewise. It is expected that this valuable support will be given this year. Georgia Tech will again provide food and lodging while the students are in Atlanta, in addition to the services of the Ceramic Engineering Department. The scholarship fees will provide travel, hotel, and other expenses of the school.

It is expected that the result of this unique educational venture will be a much wider dissemination of knowledge of mineral industries of the South. No matter what vocation a student of this school afterward takes up, he should henceforth be a focal point of information concerning this field. Specific results of past schools have included the enrollment of several students in Ceramic Engineering courses at Georgia Tech.

The Staff of the School will consist of A. V. Henry, W. Harry Vaughan, Lane Mitchell, and L. A. Tedder of the Department Staff, and Georgia State Geologist, Richard W. Smith.

LANE MITCHELL

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* For an announcement of appointments made for 1937–1938, see *Bull. Amer. Ceram. Soc.*, **16** [11] 450 (1937).

AIR HYGIENE FOUNDATION FALL MEETING

Approximately 250 persons, including industrial leaders, technical specialists, governmental officials, physicians, and engineers, attended the Fall meeting of the Air Hygiene Foundation at Mellon Institute, Pittsburgh, Pa., on November 30, 1937. The assembly heard reports by the Foundation's Medical, Engineering, and Legal Committees on recent advances toward the control of occupational disease and on current developments in the field of industrial health.

H. B. Meller, Managing Director, announced that the Foundation has arranged for scientific investigations at the Saranac Laboratory, the University of Pennsylvania, and the Harvard School of Public Health. He said that more than 190 companies are now affiliated with the organization, a nonprofit, industry-wide movement, supporting coördinated research to combat air-borne industrial disease.

Social Values

Willard T. Chevalier, New York, N. Y., in a nontechnical address to executives, said the meeting indicated industry's recognition of "social values as a very definite concern of its stewardship.

"It is necessary for industry to think not only of how much it costs to get a day's work out of a worker, but also how long a useful life will that worker have, what kind of health will he enjoy, what kind of consumer will he make for the goods and services produced by other industries.

"Look beyond today's cost sheets," he urged, asserting that the assumption of greater social responsibility on the part of industry, toward the worker and toward the community, is the best antidote for trends toward collectivism and community interference in business.

Colonel Chevalier, Vice-President of the McGraw-Hill Publishing Company, recalled that after the passage of the Workmen's Compensation Laws, industry set out to eliminate accidents. Safety engineering, a new branch of science, was developed. The accident rate was sharply reduced. Similar forceful coöperation and united action was advocated by other speakers as the effective way to combat occupational diseases now being made compensable in many states.

New York Code

Philip Drinker of Harvard University, Chairman of the Foundation's Preventive Engineering Committee, reported that "one of the most significant developments in the field of occupational hygiene during the past year has been the adoption of the New York State Code governing dustiness in rock drilling.

"This code divides all rock formations into two classes: class I, those with less than 10% free silica, by weight, and class II, those with more than 10% free silica. If drilling is done in class I rock, dust counts must be below 100 million per cubic foot, and if the rock falls in class II, below 10 million particles.

"This means, in effect, that dry drilling can be used only with local exhausts and adequate air cleaning. It happens, also, that wet drilling without ventilation will not achieve adequate air cleanliness in the case of the high quartz or class II rock.

"At this writing, it seems likely that other states will copy this code almost verbatim. After all, New York adopted it as the result of extensive investigation and hearings, and it is unlikely that other states will assemble better information on which to base their codes. It is probable that substantially this same code will be adopted for dust exposures of all kinds. If so, it will mean that the upper limit of dustiness in any kind of work and in any kind of dust will be 100 million particles per cubic foot."

Medical Report

A. J. Lanza, Chairman of the Foundation's Medical Committee, stated that a great deal of work is being done and that there is a clearer understanding of the problems of industrial hygiene.

"Various tests are coming to the fore in the effort to determine the presence of possible occupational illnesses. Briefly, there has been developed a fairly accurate test to determine whether the individual is being exposed to dangerous quantities of benzol, known as the 'urine sulfate test.' Skin tests for allergic reactions among workers exposed to various substances are being developed more and more. Blood tests, particularly those of the nature which depend upon the differential counts of blood corpuscles, are becoming more and more important and more widely used. Research work is still being done in the effort to develop means of detecting the degree of impairment in pulmonary dust diseases, an important phase, of course, of the compensation question.

"A group of hazards that has been attracting a great deal of attention, particularly in the last year, is that large number of chemical substances that are grouped under the name of solvents. The Massachusetts Department of Labor and Industry, I understand, is about to develop a rather comprehensive list of permissible concentrations in the atmosphere of working places of these various substances that are grouped loosely under the head of solvents.

"So this question is a live one. It is growing in importance because the manufacture of chemicals in this country is on the increase and has been ever since the war conditions put an end to the importation of German chemicals and developed the chemical industry in this country."

Discussing the effects of various dusts upon the health of workmen, Dr. Lanza said there is evidence that combinations of dusts "act differently from any of these dusts when inhaled by themselves." That opens quite a field for speculation. The same thing has been observed, for instance, with gases.

Hydrogen-Sulfide Danger and Cancer

M. R. Mayers, of the New York Division of Industrial Hygiene, for instance, has shown that carbon monoxide when inhaled in combination with hydrogen sulfide is more dangerous than either carbon monoxide or hydrogen sulfide when inhaled alone.

"There is also a growing interest in the subject of cancer as a possible result or as possibly being associated with industrial hazards. With respect to dust inhalation, all the evidence is negative; that there is no particular relationship between the inhalation of dust and the incidence of cancer. Other forms of irritants, such as gases, fumes, etc., may have some such effect. That topic is a live one and is being investigated, as is also the possibility that fun-

gus diseases of the lungs, perhaps, are more common than we have supposed."

Mixed and Protector Dusts

Leroy U. Gardner, of the Medical Committee, discussed the research he is undertaking for the Foundation at the Saranac Laboratory on "mixed" dusts and "protector" dusts. He said, "The evidence now available makes it seem improbable that a silica hazard is defined solely by the number and size of the silica particles in industrial atmosphere. The other components of a dust modify its action. Some may inhibit, others retard, and perhaps some will be found to prevent its injurious effects. Because these possibilities are recognized, it becomes difficult to set up definite standards of permissible dustiness in industrial atmospheres.

"Not enough is known about the action of protector substances to warrant the recommendation that they be employed to prevent silicosis in industry. Our aim should be to reduce existing dust concentrations rather than to increase them by adding more dust. I would strongly oppose the recommendation that protector dusts be used to attempt to prevent silicosis at the present time. But I do believe that we should attempt to discover more about their action. Some, like gypsum, seem to combine with the silica in the atmosphere, forming clumps which are too heavy to remain suspended in air and too large to pass the barriers of the nose and upper respiratory tract. With such information at hand it may be possible to apply the knowledge in a practical manner."

X-Ray Studies

S. Reid Warren, Jr., of the Moore School of Electrical Engineering, University of Pennsylvania, described the investigation which the Foundation is sponsoring at that institution on improving röntgenographic (X-ray) technique for industrial applications. The medical profession emphasizes the necessity for X-ray films and their proper interpretation in the diagnosis of dust diseases of the lungs. Dr. Warren described the progress in this direction and outlined the work still necessary to make this technique a standardized tool.

The projects of the Saranac Laboratory and the University of Pennsylvania constitute the continuation and advancement of fundamental work which has been accomplished at these institutions in the past.

Drilling

D. Harrington, a member of the Foundation's Board of Trustees and Chief of the Health and Safety Branch, U. S. Bureau of Mines, summed up "the whole matter of drilling" as follows:

"Dry drilling is, of course, very much more of a dust producer than wet drilling, probably in the ratio of 6, 8, or possibly 10 to 1. Wet drilling produces some dust. . . . . But if reasonable precautions are taken with wet drilling, and suitable precautions are also taken as to the ventilation, wetting the muck pile, time at which the blasting is done, and precautions which are taken after going back to the face after blasting, we feel, in fact we know, that under the present day conditions mines can be so conducted. . . . . that there need be no particular harm to workers in those places as far as dust diseases are concerned."

Legal Data

A. C. Hirth, Chairman, reviewed the work of the Legal Committee to date. He explained that the Foundation's legal surveys digest more than 400 separate occupational disease cases. Summaries are given of the laws of the various states as to occupational disease, along with the interpretations placed upon these laws.

T. C. Waters, Chairman of the Maryland Occupational Disease Commission and a member of the Legal Committee, reviewed a forthcoming critical analysis of compensation legislation which he has compiled for the Foundation and which will be issued in the near future. He stated that "during the past year, occupational disease amendments to existing Workmen's Compensation Laws have been enacted in six states: Delaware, Indiana, Michigan, Pennsylvania, Ohio, and Washington. Today there are 21 states whose laws provide compensation for occupational diseases. State commissions have been appointed for the purpose of studying and recommending compensation in eight other states: Alabama, Arizona, Georgia, Kansas, Maine, Maryland, New Mexico, and Oregon. . . . . In the course of the next few years all the industrial states probably will have enacted laws for this purpose."

More than 100 companies were represented at the meeting. The Proceedings, containing the detailed report, are available (without cost).

GLASS CLOTH WALL PAPER IS LATEST "WRINKLE"

New York Architect Pioneering in New Idea—Low-Cost Fireproof Fabric Can Be Hung by Paperhangers

Andrew J. Thomas, New York City architect, is pioneering in a fascinating application of Fiberglas cloth as now being produced by the discoverers of today's method to manufacture glass in fibrous form.

Examining a new type of cloth created recently by the Fiberglas division of the Owens-Illinois Glass Company, Mr. Thomas became intensely interested in its possibilities as wall paper.

Aware of the trend to "canvass" walls in modern buildings, that is, to paste woven cloth onto walls instead of ordinary wall paper, the Owens-Illinois research men began a series of experiments for Architect Thomas.

The practice of clothing walls grew out of a desire to cover plaster cracks that are revealed under the surface of wall paper, and to take advantage of the interesting texture and decorative possibilities.

Mr. Thomas was enthusiastic over the possibilities of glass cloth for such purposes because of the lustrous quality, reflection of light for increased illumination, and the fireproof qualities of such fabric.

Tests proved to Mr. Thomas that he could use Fiberglas cloth advantageously on walls of stair wells and other usu-

ally dark places where reflected light and bright appearance is particularly necessary.

Another application that shows interesting possibilities is in the finish of walls of bathrooms and other places where moisture is a problem.

Recently it was discovered that glass cloth for such purposes can be made to assume any pastel shade desired by gluing the cloth to colored wall paper. The color shows through the mesh of the lustrous cloth and, by using a waterproof adhesive, a completely waterproof unit is obtained. It can be washed down for easy cleaning.

With the color problem solved and a variety of weaves and textures available, the monotony of the average bathroom wall can be relieved, with interesting and unusual results, at low cost.

Mr. Thomas is supervising the construction of a New York apartment building in which he plans to use many square yards of textile glass wall paper in the foyers, elevators, and lobby. He feels that glass in this form is the key to an enticing adventure in new decorative effects.

SHUSHAN AIRPORT

Like a giant arrowhead, jutting out from the south shore into the blue waters of Lake Pontchartrain, is the Shushan Airport of New Orleans, the nation's most modern air terminal, with the finest combined land and water aviation facilities to be found on this side of the Atlantic.

Built on an artificial peninsula within twenty minutes' drive of the business district, the Airport embodies in its construction and equipment the very last word in aërial terminals. Created with an eye to the future, particularly to care for steadily increasing travel between the United States and Latin America, it is a fitting complement to the unexcelled transportation adjuncts of New Orleans.

Ordinarily, an engineer assigned the task of creating an airport is given an area of agricultural or grazing land. His work is largely confined to leveling, grading, and draining. But the Shushan Airport involved more than this in that the land that was to serve as the Airport site had to be created out of a submerged area in Lake Pontchartrain, where the water depths ranged from one to thirteen feet.

There were four reasons for such a location: (1) it would be unnecessary to pay for the site, because lake bottom is the property of the State, (2) an airport so situated could not interfere with natural street development by interposing a solid block of land in the way of normal expansion, (3) it afforded easier approach and departure and more ease in locating the field from the air, and (4), it provided facilities for sea as well as land planes.

Direction of this artificial peninsula was determined by study of the prevailing winds of the area. Then the dimensions of two large runways, converging into a triangular shape, were figured out, and an area sufficient to accommodate them was enclosed in a concrete retaining wall. The next step was to pump material from the lake bottom in behind the retaining wall and bring the entire area up to a safe level, *i.e.*, above the height of the highest storm waves yet encountered on Lake Pontchartrain. In general, all that part of the fill below lake level is composed of clay. All that above is composed of sandy material, which facilitates surface drainage.

Four runways have been constructed on this area, so that planes may take off and land into the wind no matter from which direction it is blowing. The runways on the legs of the triangle run NW–SE (this complies with the prevailing winds) and direct N–S. The other two cross immediately before the Administration Building, running E–W and NE–SW. They are of asphalt construction, chosen in preference to concrete because of cost and because of the prospect of subsidence in the field area.

As unique and modern as Shushan Airport itself is, the group of buildings housing the executive, administrative, and operative units of the port facilities. The administration building offers a commanding and unobstructed view of the entire field from the control tower. The two hangars flank the administration building and border the flying field itself. Expansion space has been provided for a total of twelve hangars and subsidiary buildings.

The outstanding feature of the administration building is the control tower, set well forward at the apex of the converging taxiways. It is octagonal, inclosed, and roofed with a special heat- and glare-resisting glass. The central element of the building is the large waiting room, floored with a tile into which is worked a giant compass design, showing direction and distance from that point to important cities of the globe by air. From this central room, doors give off to lunch rooms, ticket offices, and other accommodations, while corridors lead to the administrative offices. The mezzanine balcony overlooking the main waiting room is decorated by eight large murals depicting the conquest of distance by the airplane.

Each of the hangars is a completely equipped shop in itself and at the front of each, flanking the doors, are pylons or towers containing office space on the ground floor and on the upper floor for schools or other allied purposes. On the roofs of the hangars are located the wind indicators, port beacons, illuminated port sign, and meridian indicator. The hangar doors have a clear opening 200 feet wide and a clear height of 26 feet; in effect, the entire side wall of the building can swing upward, either in one piece or two one hundred-foot units, giving access to a one hundred and fifty-foot paved apron.

At the extreme eastern end of the field are accommodations for seaplanes, together with a hydroplane ramp, two hangars, and a subordinate administration building for that portion of the field.

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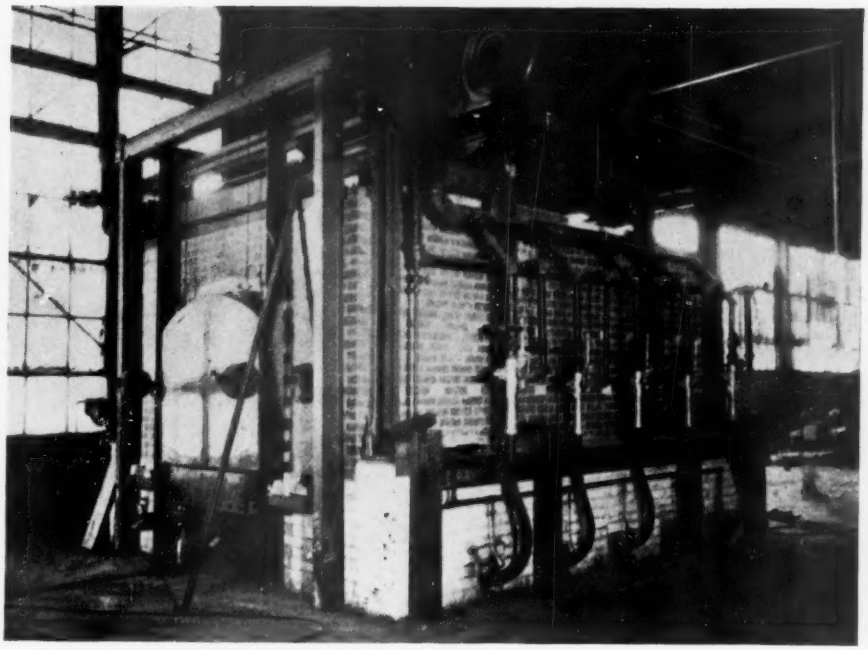

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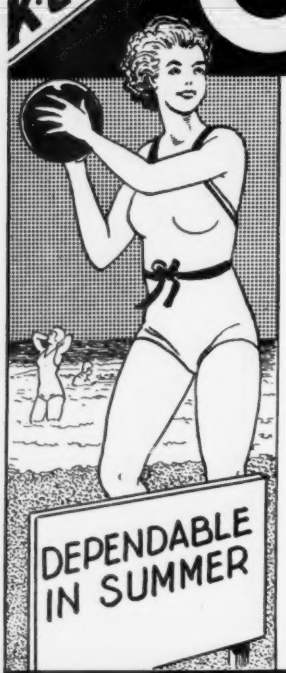

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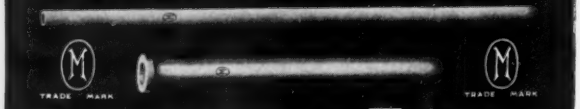
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International Congress on Glass

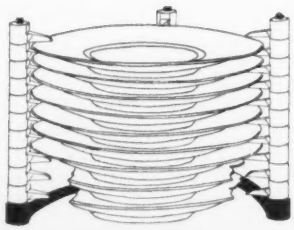
(London and Sheffield, 1936)

The August, 1936, number of the "Journal of the Society of Glass Technology" contains a complete account of the Proceedings of the Congress and the first batch of ten valuable papers by authorities of international repute.

The October, 1936, number contains 27 other papers presented at the Congress.

Copies, price 10/–d. ($2.46) each, may be obtained from the Secretary, or from the American Ceramic Society.

The Society of Glass Technology,
Darnall Road, Sheffield 9,
England



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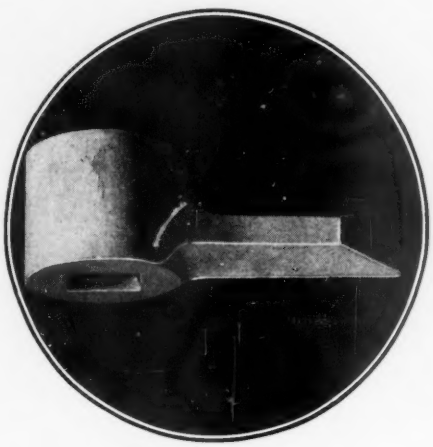

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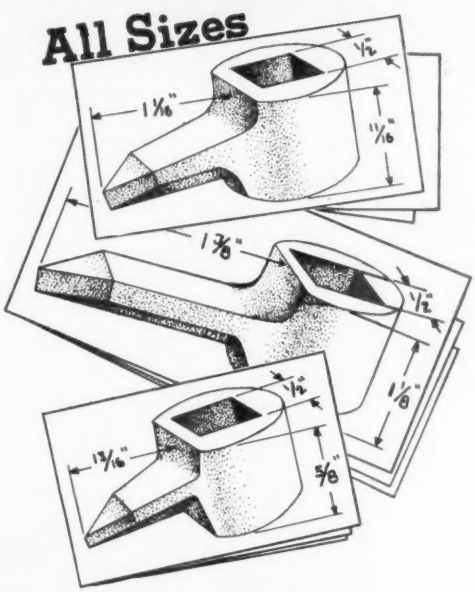

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Copper Oxides
Iron Chromate
Iron Oxides
Kryolith
Lead Chromate
Magnesium Carbonate
Manganese Dioxide
Nickel Oxide, Black
Nickel Oxide, Gray
Nickel Sulphate
Potassium Bichromate
Potassium Nitrate
Potassium Permanganate
Powder Blue
Rutile, Powdered
Selenium
Sodium Aluminate
Sodium Antimonate
Sodium Bichromate
Sodium Silicate
Sodium Silico Fluoride
Sodium Uranate
Tin Oxide
Titanium Oxide
Uranium Oxide, Orange
Uranium Oxide, Yellow
Zirconium Oxide

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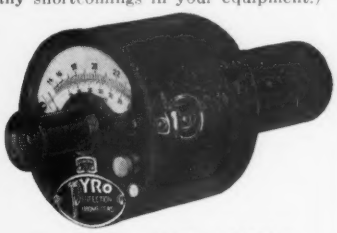

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